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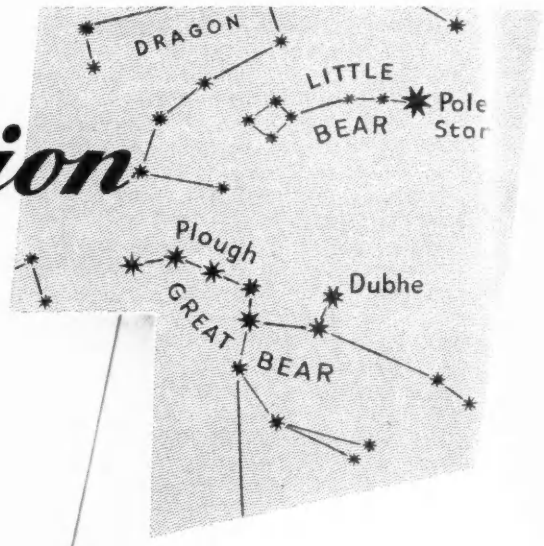

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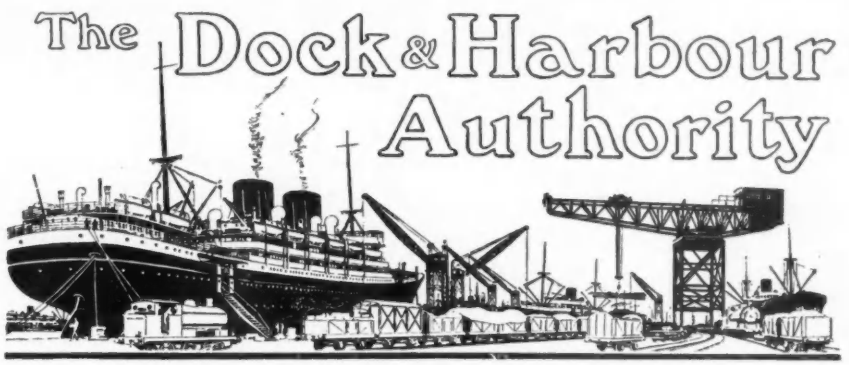

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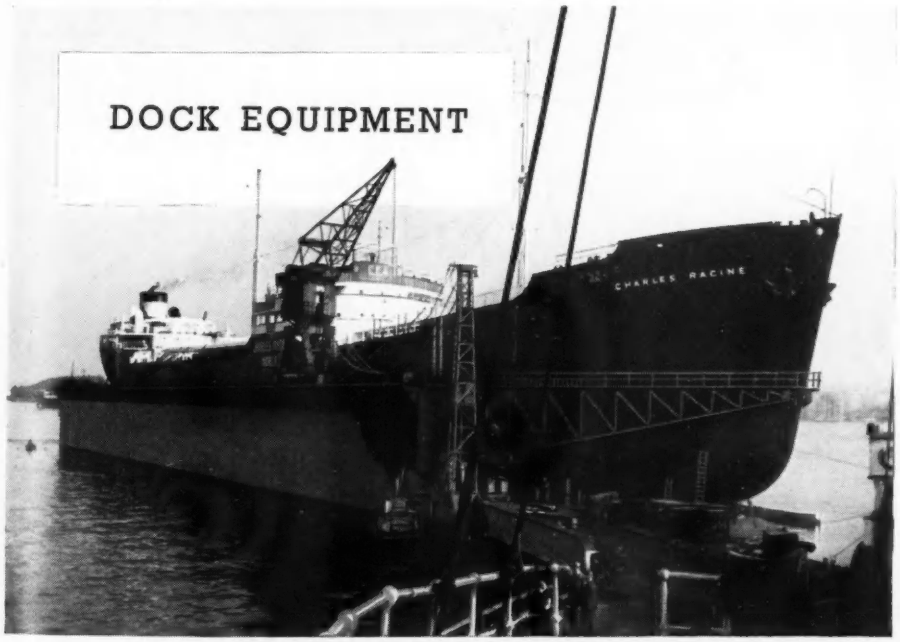

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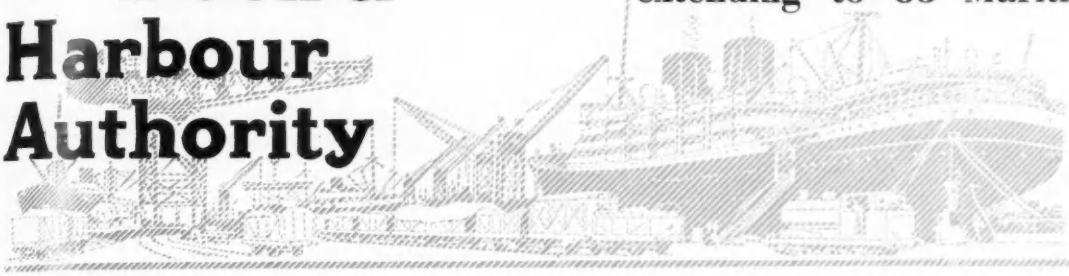


No. 420

Vol. XXXVI.

OCTOBER, 1955

Monthly 2s. 6d.

Editorial Comments

The Port of Beirut.

The subject of our leading article this month is the Port of Beirut, principal outlet for the Lebanese Republic and the hinterland of North Syria and Iraq. The port has had a varied history which goes back at least three thousand years, and in addition it is the site of the slaying of the Dragon by St.George. It was already a busy place when those pioneers of sea-borne trade, the Phœnicians, dominated the Mediterranean.

The management of the port is unusual in that control is in the hands of a French firm the Compagnie du Port des Quais et des Entrepots de Beyrouth, whose head offices are in Paris. This firm has managed the port successively under the Turks until the First World War, from 1920 to 1943 under the French Mandate, and latterly under the Government of the Republic of Lebanon. However to judge from the port's activity, and the scope of the proposed improvements described in our article, there appears to be little evidence that remote control in this instance is any disadvantage.

Higher Education for Port Workers.

As reported elsewhere in this issue, a combined cargo-handling exhibition and symposium was held last month in Antwerp, organised by the Belgian National Committee of the International Cargo Handling Co-ordination Association. The symposium concentrated on the need for higher education, both technical and humanistic, of the clerical and administrative grades of port worker, and the speakers dealt in some detail with the facilities which had been created in recent years for such education and training in Belgium. While the emphasis in this instance lay more on developing the capabilities of entrants into shipping and forwarding concerns, the same considerations might be held to apply to the recruitment of " black coated " workers into port operation and administration departments and stevedoring firms.

Inland Waterways and Port Congestion.

In an address to a transport conference held last month at the Bonar Law Memorial College at Ashridge, Mr. W. Fraser, a member of council of the Institute of Transport and an authority on inland waterway transport reviewed the prospects for development of inland waterways in Great Britain. We are very glad to have the opportunity of reproducing his address on a later page, especially since the author so clearly describes the past history and future prospects of this form of transport. From his long association with traffic on the Trent Navigation, he illustrates aptly the essentials of the matter by reference to the problems of this navigation. In recent issues we have referred to this navigation and to modest proposals of the Transport Commission for capital improvements on this and other waterways. Mr. Fraser has fulfilled a useful service in emphasising that no extensive schemes for improvement of the waterways themselves, in contrast to depôts and Commission-owned craft, are in hand, and that the preponderant wishes of independent waterway carriers are suffering in consequence.

An important aspect of this matter, admirably presented in this paper, relates to the function of inland waterway vessels in the ports. In the case of the broad gauge navigations these boats can act as lighters in dock areas, and thereby considerably relieve port congestion, since the goods do not need to pass over the quays. The relevance of this to road congestion generally will be obvious. At the same time this influences adversely those canals which cannot accommodate boats capable of operating in estuarial waters.

We also publish in this issue a factual report by Mr. R. Morton Mitchell on the extent and causes of delays suffered by motor vehicles at British ports. Undoubtedly the need for adaption of facilities at ports to accommodate increasing road transport is very urgent, and this report is a welcome contribution. Nevertheless it will be recognised that, by movement of cargoes by river and canal to an inland waterhead, with delivery thence by road, the congestion at ports can be considerably eased.

Draft Convention on Stowaways.

The text of a draft Convention on Stowaways was recently approved at a plenary session of the Comité Maritime International held in Madrid.

It has long been recognised that the stowaway on board ship is more than a nuisance. The present uncertainty and complications which exist in the treatment of the stowaway when discovered has long been a matter of serious concern to shipowners throughout the world. In 1936/1937 and on the initiative of the International Shipping Federation, endeavours were made to reach an international understanding through the then League of Nations, but it did not prove practicable to make progress through that body. Shortly afterwards, the International Chamber of Shipping was invited to pursue the matter through the Comité Maritime International which organisation agreed to include it as a subject for discussion at its Hamburg Conference in 1939. The outbreak of war then frustrated progress.

The earliest opportunity for the Comité Maritime International to resume its consideration of the problem was at its Conference in Brighton in 1954. A specially constituted International Sub-Committee representing the commercial interests of fourteen countries including all the principal maritime powers, then prepared a report on which the draft Convention has been based; the tests appears on another page. Broadly, the draft Convention proposes that

(a) Ships should be allowed to land stowaways at the first suitable port of call.

(b) A stowaway of known nationality should be repatriated to his own country which should be responsible for the cost of his maintenance and repatriation.

(c) A stowaway of doubtful nationality of " Stateless " should be repatriated to the country from which, by stowing away, he set out, the cost being the responsibility of the shipowner for a limited period.

It was recognised that political refugees, which are of course in an entirely different category to that of Stateless persons, could not be subjected to enforced repatriation.

The proposals in the draft Convention have been under close examination by the National Constituent Associations of the Comité Maritime International since the Brighton discussions. It is already evident that suggestions will be made for amending it on lines which will facilitate favourable consideration by Governments of the final proposals by the Comité Maritime International.

Editorial Comments—continued

It must not be thought that, because the number of stowaways found on board ships in the last few years may have been less than in earlier years of acute depression, the matter is now not a serious one to shipowners. It would equally be wrong for the impression to be gained that the number of stowaways in the last few years has been negligible. For example, the figures before the Brighton Conference showed that in the years 1949/1954 the total number of stowaways arriving in the United Kingdom was 3,117 while 2,194 stowaways were apprehended in the U.S.A. over the same period.

The presence on board of a stowaway can constitute a danger to the ship and to lives on board. Stowaways often endanger their own lives by hiding in cargo which collapses over them, sometimes with fatal results. They can be the cause of fires on board ship because they can smoke undetected in places where smoking is normally strictly forbidden. They actually endanger the lives of persons travelling on board by hiding in lifeboats and consuming the rations stored there for times of emergency. They can be the means of spreading disease, because until their presence is discovered they are under no health or medical supervision. When they are discovered their presence is resented by members of the crew, and there is an unsettled atmosphere pervading the whole of the crew's quarters.

An Irish-Indian stowed away in a vessel in July this year and the Immigration Authorities would not allow him to be landed. The crew would not serve with him on the grounds that the life-saving apparatus was only sufficient for the number of the crew and they were backed by their Union. However, the Immigration Authorities were adamant and one of the cadets going on leave had to sign-off earlier than would otherwise have been the case.

Few countries will allow a stowaway of another nationality to be landed at their ports; thus if a stowaway comes from a country to which the ship is not likely to sail for any length of time, the shipowner is responsible for his maintenance until such time as he can be returned to his own country. Should a stowaway be stateless, the position becomes even more complicated because it is very rare for a country to accept such a man and he may have to be carried by the shipowner indefinitely—a case is on record where a stowaway was voyaging round the world for five years unable to land because he had no citizenship and, in fact, he died on board.

The costs to the shipowner, although not the most serious aspect of the problem, are nevetheless not inconsiderable for, besides having to feed and maintain on board his vessel a person who has no training as a seaman and, therefore, is incapable of useful work, he has also to meet heavy charges in some countries in respect of guards which are put on board the vessel to stop the stowaway from landing, or alternatively to pay for the stowaway's upkeep in gaol. Furthermore, should a stowaway escape from a train, very heavy fines are often imposed on the shipowner.

Although the Immigration Authorities in many countries are sympathetic towards reasonable requests for time in which to dispose of these stateless persons, it is not easy for shipowners or their organisations to arrange for their rehabilitation.

The terms of the Convention cannot but engage the interest of all Port Authorities, whether situated in the country at which the stowaway is landed or in the country from whence he takes illicit passage. The draft plainly recognises that the port authority in whose jurisdiction a stowaway boards a ship is to some extent to blame for allowing him access to the vessel in the first instance.

Topical Notes

New Drydock for Amsterdam

A new drydock which has been constructed at Amsterdam by the Nederlandsche Dokken Scheepsbouw Maatschappij, and which will be the largest in Holland, is expected to be in operation next month. It is 800-ft. long, 130-ft. in breadth between the walls and 120-ft. wide at the entrance. The depth of water over the keel blocks will be 27-ft. 6-in. and the dock will be capable of accommodating vessels of up to 60,000 tons d.w.

The new dock will be equipped with tower cranes of 50- and 15-tons capacity. Round the perimeter of the dock, and incorporated in the sides, is a tunnel for piping in which all the pipe lines for servicing vessels will be housed—these pipes will carry salt and fresh water, steam, compressed air, and electricity cables for supplying power of varying voltages.

Three dock pumps with a total capacity of about 39,700 gallons per hour will be capable of emptying the dock in two hours. Two equalising valves 8.2-ft. dia. will enable the dock to be filled in one hour. The pump-room will also house three fire pumps which will also be used for general service duties.

The dock gate, which is of the Arrol design box type and weighs 250 tons, has been constructed and installed by the N.D.S.M. It is pivoted on trunnions resting on bearings at the face of the dock entrance and when opened lies flat at the entrance on a concrete table which runs from both sides of the entrance. It is of welded steel construction, and is approximately 131-ft. in length, 10-ft. in breadth, and 33-ft. in height. By means of 25 watertight compartments, some of which are ballasted with water, a buoyancy of 200 tons is obtained which gives an operative weight of the door of only 50 tons. The door is raised and lowered by an electric winch and steel cabie fixed to the dock side.

Extensions to the Port of Montreal

According to recent reports in the Canadian press, the Transport Minister of Canada has announced a $7m. improvement scheme for Montreal harbour. Addressing the House of Commons in Ottawa, the Minister said that the extensions resulted partially from the impending construction of the St. Lawrence Seaway. He said that during the present year a start would be made with raising the level of Sutherland Pier, in the harbour's east end, by 14-ft. He also commented on a recent announcement that the Government is planning to spend $600,000 on the road of Jacques Cartier bridge, a National Harbours property. It is expected that the capacity of this highway will be doubled.

The construction of a new transit shed in the harbour and the extension of an existing shed is to be put in hand in the near future and work is also expected to begin shortly on the construction of grain conveyor galleries along the waterfront. It is anticipated that future improvements will include facilities for berthing large Lake vessels which will use Montreal once the Seaway is completed.

During the current fiscal year two wharves are to be extended and other work carried out at a cost of $2m. It is hoped that the entire programme will be completed by the end of 1959.

During the last six months, three transit sheds covering an area of 104,000 sq. ft. have been completed at the port bringing the total additions to the port since the war to 330,000 sq. ft. Modern car dumpers have been installed at Elevators 1 and 2 and high-level wharves—almost one-third of a mile long—have been constructed at Sections 40, 41 and 42. New wharves are to be constructed at Sections 50, 51 and 52.

Fourth Convention of the Société Hydrotechnique de France

The Société Hydrotechnique de France announces the programme of their fourth Convention to be held in Paris, June 10—17, 1956.

The basic theme of the Convention will be " The Energy in the Sea." This will be considered under two main sub-divisions—mechanical and thermal. Papers will be read on waves and tides in Nature, their investigation in models and their utilisation as sources of power. There will also be papers on the damage caused by waves and tides, on coastal protection and on thermal energy.

The provisional programme envisages a three day excursion to St. Malo to inspect the tidal model of the Rance Estuary and the Rance tidal generator. Three days will be spent in Paris, where a full programme of papers and discussions will be provided, after which there will be a two day trip to Argentat and Cambeyrac to study prototype tidal turbo-generators.

Contributors of papers, which must be in French, are invited to notify the S.H.F. immediately. The full programme may be obtained from Société Hydrotechnique de France, 199 Rue de Grenelle, Paris (VII^{e}), France.

The Port of Beirut

The Resurgence of an Ancient Maritime Tradition

(Specially Contributed)

THE Republic of Lebanon is stiuated on the shores of the Mediterranean Sea, and has an area of 10,000 square miles with a population of some 1,300,000 inhabitants. It is a country of high mountains and extensive plateaux, whilst the coastal plains are irrigated by many small rivers. The climate is temperate and conducive to good agriculture. In classical times, in the pre-christian era, this was the famed land of the finest mariners of antiquity, the Phoenicians, the builders of Carthage and the sea lords of Beirut, Tyre and Sidon, and the most important shippers of Cornish tin. Today the glories and pre-eminence of the two last-named sea ports are gone and the remains are mere small villages by the shore, whereas the former has risen from a similar decrepitude in the 1880's to become the capital of the Republic and the chief sea port of Lebanon. Beirut is the administrative centre of the Republic and is situated about the middle point of the Levant coastline at about equal distances from Turkey and Egypt. To the south there is Haifa, 72 miles distant, and Alexandria, 330 miles; to the north it is 100 miles to Latakia in Syria and 170 miles to Alexandrette, Turkey.

In 1887 the Sublime Porte granted a concession to a French firm of merchants and financiers to exploit the small harbour of Beirut, which then mainly depended on the fishing industry. At that time the harbour was merely a sheltered cove in the shadow of Cape Chamieh. By 1894 a straight line breakwater 806 metres long had been constructed from the rock tip of Cape Chamieh in a E.N.E. direction enclosing an area of deep water fronting the town.

The port as shown in Fig. 1 was created by the enclosure of an area of open sea in the Bay of St. George. The breakwater was of the rubble mound type (Fig. 2a) with a relatively high (5 m.) mass concrete superstructure of simple construction and only 15-ft. wide. The seaward slope of the mound was protected with pre-cast concrete block wave breakers.

The works of the port as initiated comprised the outer breakwater, the lay-out of which was decided as early as 1863, with the end in view, in those days of sail, to leave a wide entrance of 500 metres between the head and shore at Quarantaine Point. In 1894 however, when the port was inaugurated, the width of the entrance was reduced to 150 metres by the construction of a rubble protection arm 350 metres long—rooted in Medawar Cliffs and bearing almost north and south—and a short spur rooted in the breakwater. The spur however, was actually provided to prevent waves running along the flank of the breakwater into the basin. The area of the water so enclosed was 21 hectares (54 acres). The depth of the water was 14 metres alongside the wall and 8 to 10 metres in the basin. Large vessels moored to buoys in the deeper water and discharged into lighters, whilst launches were provided for passengers.

Extension already carried out.

The elementary character of the port changed gradually and proportionately to the growth of traffic. Trade has increased rapidly in the last 20 years, and in 1934 a large project was launched for the construction of a second basin of 19 hectares (50 acres). The outer breakwater (Figs. 3 and 4) was to be extended by 490 m. in a depth of 20 m. but in place of a rubble mound type, on a question of cost and urgency, the vertical wall type was decided on. For this purpose 22 large caissons of metal 22 m. high and 11 m. wide were floated to the site, and there sunk and filled with concrete (Fig. 2b).

A new arm 330 m. long was built out from the shore to enclose the new basin of 8 m. minimum depth, to form a protection from the seas to the east, and to provide the south entrance head to the new basin. By this means 275,000 square metres of shallow sea was reclaimed as fill to the South Quay, 300 m. long, thus providing the additional storage space urgently needed. This extension provided an entrance width of 260 m. in deep water, and increased the length of quays to a total of 2,294 metres, and the port water area to 40 hectares (100 acres). It also provided moorings for 17 large vessels simultaneously. This basin was completed in 1938.

All extension work was stopped during the last war and recommenced in 1946. The installations have been more than doubled since that date: an efficient roadway system has been constructed, also a flexible railway system of triple rails permitting access to the quays and to the depots of the port for the normal and narrow gauge tracks.

Further Projected Extensions.

Already the traffic of the port has grown to unexpected dimensions necessitating still further extensions. The upward trend has been gradual and regular for a number of years, but recently it has outstripped the available facilities. In the last 4 years the tonnage of goods handled has increased by 50 per cent. In 1954, about 1,500,000 tons were handled, whereas the maximum before the war was only 650,000 tons, and in the first normal year after the war, 1947, it had only attained 510,000 tons, about one third of the present rate.

The calling of regular lines of vessels is now more frequent than hitherto, and it is not unusual for 90 per cent. of quayside and buoy moorings (Figs. 5 and 6) to be in use at the same time. The " digue-abri " (shelter arm), which was originally built to the east of the port as a simple work of protection with a width of 7 m. only, is now used as a loading and discharging jetty. It is not unusual to see six cargo ships moored alongside making as much use as they can of the slender facilities available. This situation is most inconvenient and undesirable. The Port Authority Company has therefore with the utmost urgency undertaken the further extension of the port.

This new project (Fig. 3) consists of the construction of a third basin east of the existing digue-abri, utilising this as a quay wall of the existing basin and incorporating it into a wide jetty, or mole, forming the west quay of the projected basin. A new north-south shelter arm will be constructed with its root in the rocky cape where the petrol depot is situated. The outer breakwater is to be prolonged by 1,000 metres and its alignment will be about 10 degrees to the north from the existing head. A large area of the shallower waters of the natural bay are to be reclaimed and form a storage area for the new south quay. This will increase the length of quays by 900 m. with 6 mooring berths and about 300,000 square metres of storage space, thereby raising the capacity of the port to 3,000,000 tons of general cargo.

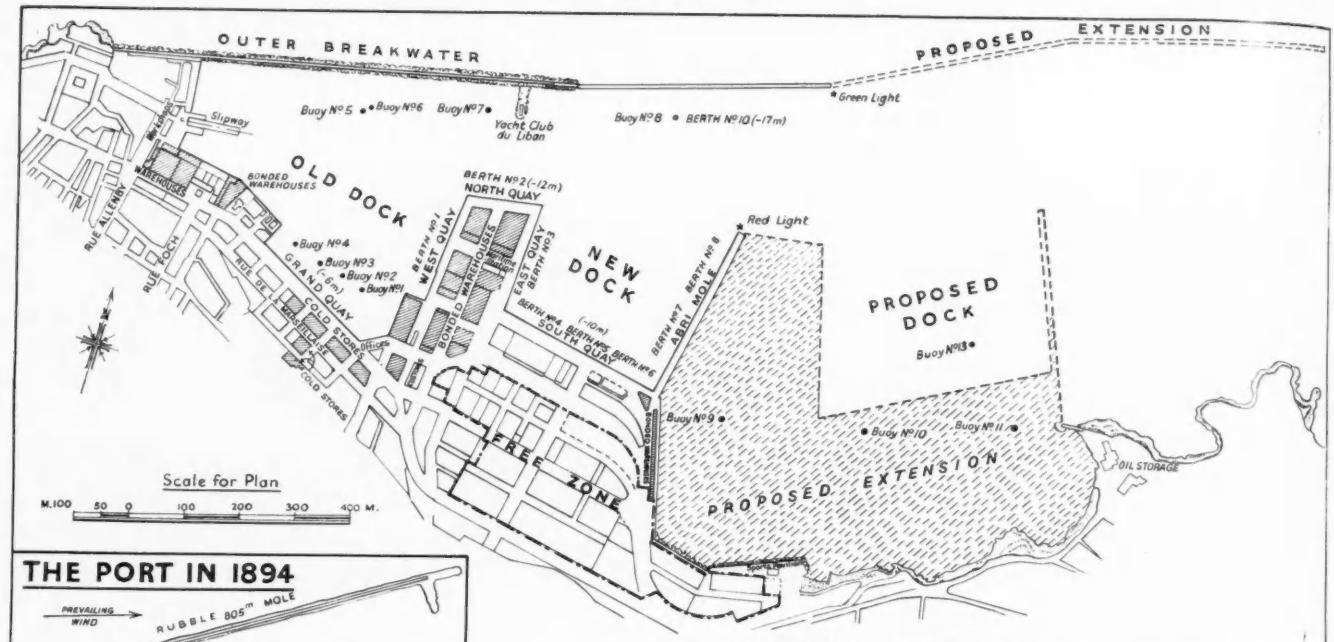
Exploitation of the Port.

The port of Beirut is managed by a French firm with head office in Paris, the " Compagnie du Port des Quais et des Entrepôts de Beyrouth." This firm is the direct heir of the Ottoman firm which in 1887 had received the concession for the construction of the port and its exploitation. It has successively directed the activity under the Turks until the First World War, then from 1920 to 1943 under the French mandate of the States of Syria and Lebanon, and then 1943-1945 under the Authority of the Government of the Lebanese Republic.

The original concession was completed May 19th, 1890 by an agreement with the Customs, permitting the Company to manage the customs sheds of Beirut and reserving to it all rights concerning the operations of receipt and despatch of all goods and merchandise through the customs over the whole extent of the concession. Later, in 1923 and in 1933, the Company was granted the right to open and exploit general warehouses and a free zone.

Within the area of the concession the Company controls actually 35,000 square metres of Customs sheds, assuring the reception and the storage of imports, exports and goods in transit, besides 12,000 sq. m. of general warehouses, including privately owned sheds placed under the control of the Customs, and of free warehouses receiving goods already passed through the Customs, or those

The Port of Beirut—continued



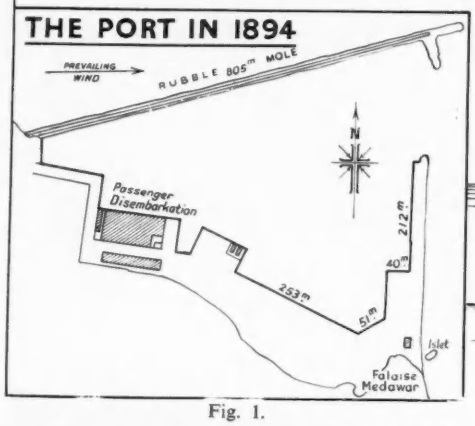


Fig. 1.

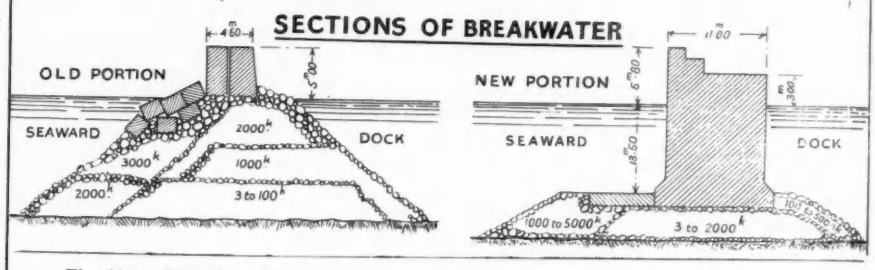


Fig. 2(a). The old rubble mound wall 62 metres wide at sea bed.

Fig. 2(b). The mass concrete vertical wall extension. Rubble base 85 metres wide.

Fig. 3 (Main Plan). The existing harbour and proposed new extensions.

Fig. 4. Aerial view of the harbour and town of Beirut.

of local production. The Free Zone covers an area of 106,000 sq. m.

The port operations are arranged according to the following general pattern; the vessels discharge their goods at the quays or to lighters alongside mostly by their own winches and derricks. The port does not have quayside cranes. The tradition organisation favours the system whereby the agencies of the Shipping Companies deal with the handling of all goods from shipboard to quay, and then to the door of the sheds, where the Company of the Port takes charge of them. Thereafter the transport, allocation, reception, despatch, stowage and all other wharfage services are in charge of the Company of the Port. For cargo handling purposes, the Company has an efficient system of mechanical equipment, fixed and travelling cranes, fork lifts, elevators, conveyors, lorries, tractors, tugs, transporters, pallets and slings. Besides these, the Company owns floating cranes of 30 and 50 tons capacity for heavy lifts.

A certain number of specialist services are run entirely independent of the Company, such as Harbour Master's Department, pilotage, quarantine, lighthouses and police.

The Free Zone.

The Free Zone is one of the main factors for the activity of Beirut port. Installed in 1933 it supplies the maximum facilities for transit, since it is, in addition to being the chief Port of Lebanon, also the port of several neighbouring States which, on account of their geographical situation, relative to the Mediterranean, become largely dependent on Beirut for their overseas trade. This applies principally to Syria, of which the capital, Damascus, and all the south, have no other rapid outlet to the Mediterranean; and Jordan, which after the closure of Haifa to Arab traffic, had only Akaba on the Red Sea to depend on. Again, Iraq prefers to route her traffic via Beirut rather than Basrah, and Iran and Turkey find Beirut a convenient and satisfactory port for speed of despatch.

The port of Beirut also serves as a calling place for the transhipment of merchandise to

The Port of Beirut—continued

be delivered to different parts of the Near or Middle East. In this connection an important traffic with almost regular services has now been established for several years with all the ports of the Arab peninsula from Port Said to the Persian Gulf. For these reasons it was found convenient and useful to set aside a part of the port zone as free trading territory outside Customs control and, indeed, outside the jurisdiction of Lebanon. Here, with the minimum of formalities, goods can be imported and re-exported, either in their original state or after undergoing any transformations required.

It has been proposed and urged by some to go even further and make the entire port into a free port for the whole of the Near East.

The free zone, which was originally of 8,000 square metres covers in 1955 an area of 106,000 sq. m., and constitutes an independent unit with public warehouses and buildings, storage areas, private sheds, factories, workshops, exhibition halls and sales rooms. There are now 114 commercial and industrial firms of all nationalities installed in the free zone. Some are tenants of the Company of the Port and others occupy their own property, according to the technical necessities of their business.

Several of these firms are installed in factories or workshops, where they treat raw materials, or products half finished, or deal with the assembly of parts, or make any other transformation prior to re-export to other countries. More than 1,500 workmen are employed daily in these establishments. There one will find factories for the conditioning and dehusking of dried vegetable grains, factories for the preparation of gut, for the curing and preparation of tobacco, no less than 13 factories for the manufacture of underwear and clothing, 2 factories for the manufacture of perfumes, a laboratory for the production of pharmaceutical preparations, a workshop for the preparation of furs, a cold store with cold chambers and installations for the rapid freezing to minus 18 deg. centigrade, and a vast bazaar where an extensive trade in Persian carpets is carried on.

The activity of this zone translated into figures is significant.

Year		Produce
1934	...	6,000 tons
1950	...	160,000 tons
1951	...	245,000 tons
1952	...	313,000 tons
1953	...	300,000 tons
1954	...	350,000 tons

However, the increase of the international traffic in transit through the free zone, relative to the total amount of foreign goods entered, is still more impressive. In 1952 it was 40 per cent., whereas in 1954 it had risen to 80 per cent. (280,000 tons). The remainders were absorbed by Lebanon. This international traffic is for the greater part through transit imports from Europe to Asia, in 1954 176,000 tons and, in the other direction, Asia to Europe, the through transit exports were 95,000 tons. It should be noted that there is also an extensive traffic through the customs with Syria.

Fig. 5. A view of shipping in the old basin.

Fig. 6. Near vessel moored to buoys alongside the outer breakwater.

Beirut and its Hinterland.

Beirut is 100 kilometres from Damascus, 300 kms. from Amman, 400 kms. from Aleppo, 1,000 kms. from Bagdad and 2,000 kms. from Teheran, Kuwait or Qatar. The traffic is by road or rail, the principal connection being the road from Beirut to Damascus, which then forks into two branches, one towards Amman and Jerusalem, and the other to the north towards Homs, Hama, Aleppo and North Syria, and to Bagdad and Teheran, then to Kuwait and Qatar on the Persian Gulf. These last connections are by roads or tracks with asphalt surfaces. A large scheme is being prepared for the construction of roads for rapid motor traffic.

There are two rail systems, a narrow gauge running to Damascus, Jordan and Hedjaz, whilst a standard gauge leads to Tripoli, Aleppo, Turkey, the wheat fields of Syria, then to Mussul and Bagdad. There is also a politically interrupted south line to Haifa and Cairo. Beirut is therefore centrally placed with its communications. When the current project of widening the road and improving the mountain pass stretches has been completed, the privileged position of Beirut will be even stronger.

Apart from the favourable situation on the coast and its progressive port, Beirut is a strong commercial centre with well established and reputable banks and a free exchange market having economic relations throughout the world.

Lebanon still lacks a merchant fleet and a number of commercial firms are endeavour-

The Port of Beirut—continued

Fig. 7. A passenger liner alongside the Maritime Station.

ing to establish a shipping line—it is hoped, before the end of 1955.

Traffic of the Port.

In 1954, the traffic of the port totalled 1,505,000 tons, imports comprising 1,129,000 tons, and exports 376,000 tons.

The number of vessels and sailing ships entered was 2,342, of which 1,864 were liners and cargo vessels of a total registered tonnage of 3,920,000.

The number of passengers (excluding tourists and pilgrims for Jerusalem or Mecca) is 54,000 per year, landed and outgoing.

The principal imports are hydro carbons of 400,000 tons, building materials, steel, timber, feeding stuffs, flour, rice, sugar, motor cars and machinery.

The principal exports are phosphates from Jordan (50,000 tons), Lebanese iron ore (40,000 tons), Syrian cereals (47,000 tons), dried vegetables, onions, bran and fruits.

Air Communications and Tourist Traffic.

There is a large airfield at Beirut with a daily air service connection with all the principle countries of the Middle East and also with other parts of the world through the International Airlines, whose planes land at the Beirut International Airport, one of the finest and most modern airfields, with all the facilities to ensure speedy commercial travel.

A modern and powerful radio-telegraphic and radio-telephonic station operates 24 hours daily in service with all capitals of the world and the Near and Middle East.

Beirut is becoming popular as a tourist centre not only for its surrounding scenery and amenities but also as a convenient centre from which visitors and pilgrims may reach most of the classical moslem and biblical holy places. Indeed in Lebanon itself the archeological sites draw increasing numbers of tourists from all quarters of the globe. Byblos, the most ancient city in the world, lies between Beirut and Tripoli. Here one comes into contact with remnants of ancient Phoenician history, 5,000 years old; in fact the country abounds in remains and traces of the incursions and colonisations of Assyrians, Pharaonic, Romans, Greeks, Franks and Arabs. From January to May there are the winter sports in the hills behind Beirut which attract increasing numbers of visitors every year and thus increase the prosperity of the town and port.

Shipowners' Liability and Treatment of Stowaways

Two Draft Conventions agreed at Madrid

Draft Conventions relating to Shipowners' Liability, and to Stowaways were adopted in principle at the Conference of the Comite Maritime International held in Madrid from September 18th to 26th, 1955. This Conference followed the preparatory meeting of the Permanent Bureau and selected national delegates which was held in Brighton, England, in September, 1954, and to which reference was made in the "Dock and Harbour Authority" of October, 1954.

Shipowners' Liability.

The Draft Convention of Limitation of Liability of Shipowners was approved by 10 votes to one, with seven abstentions. The American delegation voted against the motion because the United States wishes to base the Convention on the American system. Among these seven delegations abstaining was the British, who asked that it should be made the owners' burden to show that an accident did not occur with his fault or privity. This is the system in Britain, but Continental nations, which find it difficult to discharge this burden, wish to place it on the person attempting to show that an owner is not entitled to a limit. Denmark, Finland, Norway, Portugal, Spain and Sweden wished to reserve the right to limit liability for small vessels to the value of the vessel or £64 sterling per ton, whichever be less. The Conference resolved to ask the Belgian Government to call a diplomatic conference. All the reservations will be incorporated in the information to be laid before the conference, which will probably be held in May next year. The text of the draft Convention is as follows:

Article 1

The owner of a sea-going ship shall not be liable beyond the amount specified in Article 3 of this Convention in respect of any of the following claims where the occurrence giving rise to the claim has taken place without his actual fault or privity. The said claims are claims made by any person whatsoever in respect of

(a) loss of or damage to any property on board the ship or received by the master or any member of the crew for transportation by the ship, or by any other servant or agent of the owner at any quay, wharf or other like place, or on any raft, craft, lighter or like receptacle, for such transportation.

(b) loss of or damage to any property or rights of any kind, or loss of life or personal injury caused to any person, whether on land or water, by any act, neglect, or default of the master or the pilot or any member of the crew or any servant or agent of the owner or any other person for whose act, neglect or default the owner is responsible, whether on board the ship or not, performing any duty or doing any act on or in connection with the navigation or management of the ship, or with persons, cargo or other property on board the ship, or in process of boarding or being put on board the ship or at any quay, wharf or other like place, or on any raft, craft, lighter or like receptacle, for carriage by the ship or after disembarkation or discharge therefrom.

(c) any obligation or liability, imposed by any law relating to the removal of wreck, arising from or in connection with the raising, removal or destruction of any ship (including anything on board the ship) which is sunk, stranded or abandoned, which said obligation or liability is hereinafter referred to as "wreck liability."

(d) loss of or damage to any property or rights of any kind, or loss of life or personal injury caused to any person, whether on land or water (not being any loss, damage or injury to which the preceding provisions of this Article apply), for

Shipowners' Liability and Treatment of Stowaways – continued

which the owner is liable by reason only of his ownership, possession, custody or control of the ship.

Provided that nothing in this Article shall be taken to apply to:—

(i) Claims for salvage or for general salvage contributions:

(ii) Claims against the owner of a ship made by any master, member of the crew or other servant in the employment of the owner under any form of compensation or insurance which is compulsory under the law governing such employment.

(iii) Claims against the owner of a ship in excess of those defined in sub-paragraph (ii) made by any master, member of the crew or other servant in the employment of the owner, if under the law governing such employment such claims are in any event recoverable in full against the owner.

Article 2

(1) The limits of liability prescribed by Article 3 of this Convention shall apply to the aggregate of all claims in respect of loss of life, personal injury, loss of or damage to property or rights and wreck liability, which arise on any distinct occasion without regard to any claims in respect of such loss, injury, damage or wreck liability which may have arisen or may arise on any other distinct occasion.

(2) Where the owner of a ship limits his liability in accordance with the provisions of this Convention for claims in respect of such loss, injury, damage or wreck liability arising on a distinct occasion, the aggregate amount of his limited liability for those claims shall constitute one limitation fund.

Article 3.

(1) The amounts beyond which the owner of a ship, in the cases specified in Article 1 of this Convention, shall not be liable are:—

(a) for claims in respect of loss of or damage to property or rights or wreck liability (such claims being referred to in this and the next following Article as "property claims"), an aggregate amount not exceeding £24 for each ton of the ship's tonnage;

(b) for claims in respect of loss of life or personal injury caused to any person (such claims being referred to in this and the following Article as "personal claims") an aggregate amount not exceeding £50 for each ton of the ship's tonnage.

Provided that, where the established personal claims in aggregate exceed £50 for each ton of the ship's tonnage then

(i) if there are also persons having property claims, there shall be ascertained the sum of the established property claims and the sum of the unsatisfied balances of the established personal claims, and that part of the limitation fund which represents the limit of the owner's liability for property claims shall, without prejudice to the provisions of Article 4 of this Convention, be divided between the persons having unsatisfied balances of established personal claims in the ratio of the sum of the established property claims to the sum of the unsatisfied balances of the established personal claims; and

(ii) If there are no persons having property claims, the limit of liability prescribed for personal claims shall be increased by a further £24 for each ton of the ship's tonnage.

(2) For the purpose of ascertaining the limit of an owner's liability in accordance with the preceding provisions of this Article the tonnage of a ship of less than 500 tons shall be deemed to be of 500 tons.

(3) Where the owner of a ship limits his liability in accordance with the provisions of this Convention, then for the purposes of any proceedings in any state with respect to that liability those amounts may be converted into the national currency of that state at the rate of exchange prevailing at the date when the owner's claim so to limit his liability is allowed by the competent court, or if before that date the owner has made payment into court in respect of that liability or has established a limitation fund or has provided bail or other security in accordance with Article 5 of this Convention, at the date of such payment, establishment or provision, as the case may be.

Article 4

Where the owner of a ship limits his liability in accordance with the provisions of this Convention, the order in which the persons having personal claims shall rank among themselves against the limitation fund shall be determined in accordance with the domestic laws of the state in which the fund is constituted.

Note: The question of the localities in which the limitation fund may be established has been reserved for further discussion.

Article 5

(1) Where in respect of any claim for which the owner of a ship may limit his liability under this Convention the ship is arrested and bail or other security is given for an amount equal to the full limit of the owner's liability in respect of the loss, injury, damage or wreck liability giving rise to that claim and all other claims which, upon the owner limiting his liability in accordance with the provisions of this Convention, would constitute one limitation fund, the bail or other security so given shall, subject to the provisions of Article 4 of this Convention, be available for the benefit of all persons making such claims.

(2) Where in respect of any such claim a ship is arrested within the jurisdiction of any of the contracting states in circumstances in which the arrest is permitted under or not contrary to the International Convention Relating to the Arrest of Seagoing Ships signed at Brussels on 10th May, 1952, the court or other appropriate judicial authority of that state may order the release of the ship.

(a) if satisfied that

(i) the owner has already given satisfactory bail or other security for an amount equal to the full limit of his liability in respect of the loss, injury, damage or wreck liability giving rise to that claim and all other claims which, upon his limiting his liability in accordance with the provisions of this Convention, would constitute one limitation fund, and

(ii) the bail or other security is available for the benefit of the claimant in accordance with his rights; or

(b) if satisfied that

(i) the owner has already given satisfactory bail or other security for an amount which is less than the full limit of his liability in respect of the loss, injury, damage or wreck liability giving rise to that claim and all other claims which, upon his limiting his liability in accordance with the provisions of this Convention, would constitute one limitation fund, and

(ii) the bail or other security is available for the benefit of the claimant in accordance with his rights.

Provided that the owner shall give such further bail or other security as would when added to the bail or other security already given equal the amount of the full limit of his said liability.

(3) In every case in which a ship has been arrested in respect of any such claim and in such circumstances as are referred to in paragraph (2) of this Article, the court or other appropriate judicial authority of the contracting state within whose jurisdiction the ship is arrested shall, in the exercise of its jurisdiction in accordance with the provisions of the said paragraph, take all steps within its power to ensure that in all the contracting states taken as a whole, the aggregate bail or other security required does not exceed the amount of the full limit of the owner's liability in respect of that claim and all other claims which, upon his limiting in accordance with the provision of this Convention, would constitute one limitation fund.

(4) All questions of procedure relating to proceedings in pursuance of this Article and questions relating to the limitation of time within which such proceedings may be brought shall be determined by the domestic laws of the contracting state in which the proceedings are brought.

Shipowners' Liability and Treatment of Stowaways—continued

Article 6

(1) In this Convention, any reference to the liability of the owner of a ship, however worded, shall be taken to include a reference to any liability of the ship.

(2) Subject to the provisions of paragraph (3) of this Article, the preceding provisions of this Convention shall apply to any of the following persons, namely:—

(a) masters and members of the crews of ships.

(b) charterers, managers and operators of ships and their agents, and

(c) any agents of the owners of ships,

as they apply to the owners of ships, provided that the aggregate amount of the limited liability of the owner and all such persons in respect of any loss, injury, damage or wreck liability arising on the same occasion shall not together exceed the amounts specified in Article 3 of this Convention and shall constitute one limitation fund.

(3) Where an occurrence giving rise to any of the claims mentioned in Article 1 of this Convention is due to the fault of the master or any member of the crew (whether or not he be at the same time solely or partly owner, charterer, manager or operator of the ship) the occurrence shall not be deemed to have taken place with his actual fault or privity, whether as master or member of the crew, as the case may be, or if he be at the same time solely or partly owner, charterer, manager or operator of the ship, as sole or part owner, charterer, manager or operator, as the case may be, if his fault were only a fault of navigation or management of the ship.

Stowaways.

A draft Convention on Stowaways, prepared by the British Maritime Law association was approved; the text is as follows.

Article 1

In this Convention the following expressions shall have the meanings hereby respectively assigned to them:

"Stowaway" means any person who secretes himself and goes to sea in a ship without the consent of the owner or master of the ship or of any other person in charge of the ship.

"Port of embarkation" in relation to a stowaway means the port at which the stowaway boards the ship on which he is subsequently found.

"Port of disembarkation" in relation to a stowaway means the port in a Contracting State at which the stowaway is landed and delivered to the appropriate authority at that port in accordance with the provisions of this Convention.

"Appropriate authority" means the body or person at the port of disembarkation authorised by the Government of the State in which that port is situate to accept and deal with stowaways in accordance with the provisions of this Convention.

"Owner" includes any character to whom the ship is demised.

Article 2

If a stowaway is found on board a ship registered at a port in a Contracting State, the master of that ship may land the stowaway at any port in a Contracting State which he considers suitable for the stowaway to be dealt with in accordance with the provisions of this Convention and there deliver him to the appropriate authority:

Provided that if the master is satisfied that the stowaway is a political refugee he shall not land him at any port in a State from which he is a political refugee.

Article 3

(1) When a stowaway is landed and delivered to the appropriate authority at the port of disembarkation,

(i) the master of the ship shall give to the appropriate authority all information in his possession relating to the nationality, or, as the case may be, the nationalities, of the stowaway, and his port of embarkation.

(ii) the appropriate authority shall accept the stowaway and deal with him in accordance with the following provisions of this Article.

(iii) the appropriate authority shall return the stowaway to any State of which he is a national. If a State to which it is accordingly proposed to return a stowaway refuses to accept his return on the ground that he is not a national of that State, or where the stowaway is a national of more than one State, all the States to which it is accordingly proposed to return him refuse to accept his return on the ground that he is not a national of any of those States, or if the appropriate authority are satisfied that the stowaway possesses no nationality, they shall return him to his port of embarkation:

Provided that in any case where the appropriate authority are satisfied that the stowaway is a political refugee they shall not return him to a State from which he is a political refugee.

(2) A Contracting State shall accept any stowaway who is returned to that State in accordance with the provisions of this Convention.

(3) For the purposes of this Article, the appropriate authority may, in any case where they are not satisfied as to the port of embarkation of a stowaway, treat as his port of embarkation the last port at which the ship called prior to his being found on board the ship.

Article 4

(1) When a stowaway is returned to a Contracting State of which he is a national in accordance with the provisions of this Convention the expense of so returning him and the expenses of his maintenance at his port of disembarkation from the time when he is landed at that port until he is so returned shall be defrayed by that State.

(2) When a stowaway is returned to his port of embarkation in accordance with the provisions of this Convention the expense of so returning him and the expenses of his maintenance at his port of disembarkation from the time when he is landed at that port until he is so returned shall be defrayed by the owner of the ship. The liability of the owner of a ship under this paragraph for the expenses of maintenance of a stowaway shall not exceed the amount of such expenses for a period of two months from the time when the stowaway is landed at his port of disembarkation.

Article 5

Nothing in this Convention shall prejudice any right which the master of a ship may have to land a stowaway at any port in a State which is not a Contracting State.

[Explanatory notes have been supplied by the B.M.L.A. in elucidation of the wording of the draft. Extracts from these, in so far as they have a bearing on Port Authorities in relation to stowaways are given hereunder.]

Article 1. In defining "stowaway" the wording in the relevant part of s.237 of the British Merchant Shipping Act, 1894, which relates to stowaways, has been followed in substance.

The definition of "appropriate authority" is so worded as to infer that the Governments of Contracting States will in fact authorise some body or person at all their ports to accept and deal with stowaways in accordance with the Convention. It has been thought to be wiser not to place any specific obligation on Contracting States to appoint an appropriate authority at all their ports since they would be unlikely to agree to a provision of that kind. As it is considered that, in practice, a master would be unlikely to land a stowaway at a port at which there were no facilities for dealing with stowaways, no difficulties should arise.

Article 2. The ports at which the master can land stowaways are not restricted to ports on the ship's contractual voyage as it is thought that countries might seek to prevent a stowaway from being landed at a particular port on the ground that that port was not on the ship's contractual voyage. On the other hand, by not so restricting the ports at which a master can land stowaways the master is in fact being given a power to change his route and call at a port which may not be on the vessel's voyage. In this way the master could it is thought justifiably depart from his route in order to land a stowaway without such departure constituting a "deviation" from the vessel's contractual voyage. (See Art. IV, rule 4 of the Hague Rules.)

Article 3. It is considered more appropriate that a stowaway should be returned to the State in which the port at which he boarded the ship is situate, since to some extent his being able to board the ship at all would probably be due to some fault on the part of the port authorities.

Intrusion Grout Mixed-in-Place Piles

Developments and Applications of a New System of in situ Piling *

The "Mixed-in-Place Intrusion Grout" procedure consists of injecting Intrusion grout through a hollow shaft to a rotating mixing head which mixes it with the soil in place. The result is a pile-like column of considerable load-carrying capacity useful for both bearing piles and cut-off walls. After a decade of research and development, the process has been so tested and perfected that it has been successfully used on several difficult foundation stabilization problems this past year. It seems probable from the experience thus gained, that many other foundation problems may be satisfactorily solved by the utilization of this process.

Development of the Process.

Soon after the authors' firm entered the field of soil stabilization some fifteen years ago, they were confronted by the problem of how to stabilize fine-grained clays, silts, and sands.

The first successful procedure was to completely remove the soil with a continuous flight auger and refill the hole with Intrusion sand grout. While this method solved the problem, it was thought that a more economical method could be found. In a sandy soil, it seemed to be rather foolish to remove the sand and then replace it with a sand grout. In this type of material the soil and grout could be mixed-in-place using the in situ sand as a fine aggregate. In a clay soil the same process might be applied using the in situ clay as a filler to cut down the amount of grout required.

With this possibility in mind, experimental equipment was designed, constructed, and tested. Small-scale field tests were run on field jobs and results proved the idea feasible.

Some time later, the Bureau of Yards and Docks of the Navy became interested in the process as it applied to soft soils.* After some delay, a test program was initiated under the Navy's direction using Intrusion grout and with Intrusion-Prepakt, Inc., furnishing personnel experienced in this type of work. Intrusion grout was selected because it has properties which give it a greater scope of injection and the ability to mix with and to penetrate a greater number of soil types than ordinary cement grout. Intrusion grout contains the admixes Alfesil and Intrusion Aid. Alfesil is the trade name for a very finely divided siliceous material which reacts with the lime liberated during the hardening of portland cement to form insoluble, strength-producing compounds. Intrusion Aid, when used in appropriate small quantities, imparts to the grout mixture the properties of a colloidal suspension, reduces the water requirement for equal fluidity, delays the early stiffening of the grout fluid, and reduces or eliminates the setting shrinkage noted during the hardening of cement-water pastes. A thorough investigation of alluvial material was made under this program.* During the first part of the program, small-scale elements were placed in five-foot mud boxes of soft alluvial mud. After a reasonable curing period, the elements were removed from the boxes, inspected, and cut into sections for load testing. Later, large-scale field tests were made in the San Francisco Bay Region during which 12-inch diameter elements were placed to a depth of from 30 to 40 feet in soft silty clay deposits and load tested.

Development of Equipment.

Up to this time, all the work on this process had been of an experimental nature using laboratory and small, light equipment. The problem now was to develop and construct equipment capable of placing the mixed-in-place elements on actual jobs. The resulting piece of equipment consists of a highly mobile, truck-mounted rig as shown in Fig. 5. The grout mixing and pumping equipment along with the equipment for placing the mixed-in-place elements are mounted and operated on a single truck. This self-contained unit is all the plant that is required for the mixed-in-place process. At present, these units are capable of working to a depth of 30 feet in a single operation. For greater depth, additional lengths of drill rod can be added. Mixing heads are available in sizes varying from 12 inches to 24 inches in diameter.

Procedure.

The process consists of pumping a neat, or sanded, Intrusion grout through a rotating drill rod. The mixing head on the bottom of this rod has vanes which mix the soil with the grout as the mixing head is forced down into the material. The grout is pumped on both the downward and upward travel to assure thorough mixing and the filling of all voids. The setting time of the material is slow enough so that reinforcing steel can be placed in the mixed-in-place element from the top after the mixing head is removed.

The amount of Intrusion grout which is mixed with the soil is dependent on the volume of voids in the material. The quantity of grout pumped varies from 30% for fine sands and compacted clays to 60% for loose sands and soft clays. Lateral spread in porous zones frequently increases the grout take, but the additional stabilization thus obtained is highly advantageous.

The strength of the soil-cement element is largely dependent on the soil encountered, but it can be adjusted to some extent by

TABLE SHOWING COMPARISON OF MIXED-IN-PLACE ELEMENTS IN VARIOUS SOILS

LOCATION	CLASSIFICATION OF SOIL	COMPRESSIVE STRENGTH-psi. 28 Days	PERCENT OF INTRUSION GROUT	MIX	
				CEMENT:ALFESIL (CU. FT.)	WATER (GALS.)
Chicago, Illinois	Fill material containing ashes, cinders, wood, hard lumps of clay, etc.	558	32 to 40	2:1	15
Atlanta, Georgia	Micaeous silty clay.	862	30	2:1	15
Stockton, California	Adobe	1450	38 to 40	2:1	17
Los Angeles, California	Fine sand fill (Hydraulic).	1655	34 to 36	2:1	17
Miami, Florida	Fine sand fill (Hydraulic) underlain by a highly organic silty clay.	2512	30	3:1	18
San Francisco, California	Soft grey silty clay.	1031	36	3:1	18
Anniston, Alabama	Stiff brown clay.	1090	51	3:1	18
Denver, Colorado	Sandy gravel with gravel particles up to 1 1/2-inch max. size	4627	38	3:1	20

Fig. 1. Table indicating compressive strengths for Intrusion Grout piles mixed in various types of soil.

*This article (slightly abridged) was presented as a technical paper before the Soil Mechanics and Foundation Division session, of the American Society of Civil Engineers national convention, at Atlanta on February 19th, 1954. The authors are N. L. Liver, jnr., M.ASCE., E.C. Mardorf and J. C. King, A.MM.ASCE.

*Reference article entitled "Rotary Mixed-in-Place Grouting Found Feasible," February 1953 "Civil Engineering, page 74.

Intrusion Grout Mixed-in-Place Piles—continued

changing the composition of the grout mix. Also, in soils that take a low percentage of grout, the strength can be increased by pumping a greater quantity of grout which will force some of the soil from the hole.

The Intrusion grout mixes used vary from 2 bags portland cement, 1 bag Alfesil and 15 gallons of water to 3 bags of portland cement, 1 bag Alfesil and 17 to 20 gallons water, plus Intrusion Aid in the amount of 1% by weight of the cementing materials. Leaner mixes are used for sandy soils, while richer mixes are used in soft clays and silts. The table in Fig. 1 shows a comparison of the compressive strengths in various soils of specimens either cut or core-drilled from the elements.

The depths to which Mixed-in-Place Intrusion Grout Elements are placed vary with the typye of soil and the diameter of the column. Operational difficulties which develop when very stiff soils are encountered limit the depth to the torsional force required to turn the mixing head. When this force increases to such an extent that it equals the power of the machine the depth limit is reached. In our experimental work, as well as in the actual field jobs we have completed, the following depths have been attained:

12 inch diameter—58 feet
18 inch diameter—50 feet
24 inch diameter—30 feet

Uses.

These elements are readily adaptable for use in the following types of work:

1—Soil stabilization.
   (a) Stabilization of fills behind bridge abutments and retaining walls, etc.
   (b) Stabilization for airport runways, pavement slabs, etc.
2—Support piling.
3—Cut-off walls.
4—Cofferdams and shoring to replace sheet piling.
5—Jetties and groins for beach and shore protection.
6—Underpinning of foundations.
7—Anchor units for towers.

Soil stabilization. The mixed-in-place procedure has been used in a number of projects. At a job in Michigan, these elements were used to stabilize a loose sand fill behind an abutment, thereby removing the pressure which was pushing the structure into the river, as shown in Fig. 3. The drawing (Fig. 2) shows 40 elements 12 inches in diameter and from 30 to 43 feet in length placed in two staggered lines across the width of the fill along the back side of the abutment.

Cut-off wall. Mixed-in-place piles were used at Mobile, Alabama, in place of sheeting for several shallow excavations. This was accomplished by overlapping adjacent elements to construct a cut-off wall. In one excavation, 8 feet x 12 feet x 7 feet in size (Fig. 4) 54 overlapping elements 12 inches in diameter were placed around the perimeter to a depth of 10 feet. The sandy soil was then excavated without danger from flowing soil. The piles were then used for the outside form of the concrete wall to be placed in the excavation. This reduced the volume of the soil to be excavated and the thickness of the concrete wall. At the completion of the job, there was no back-filling or sheeting to be removed. This also prevented the usual street settlement that occurs when street excavations are backfilled. The tops of the piles were at the same elevation as the surface of the street which allowed the street to be opened for traffic during rush hours by covering the excavation with heavy steel plates.

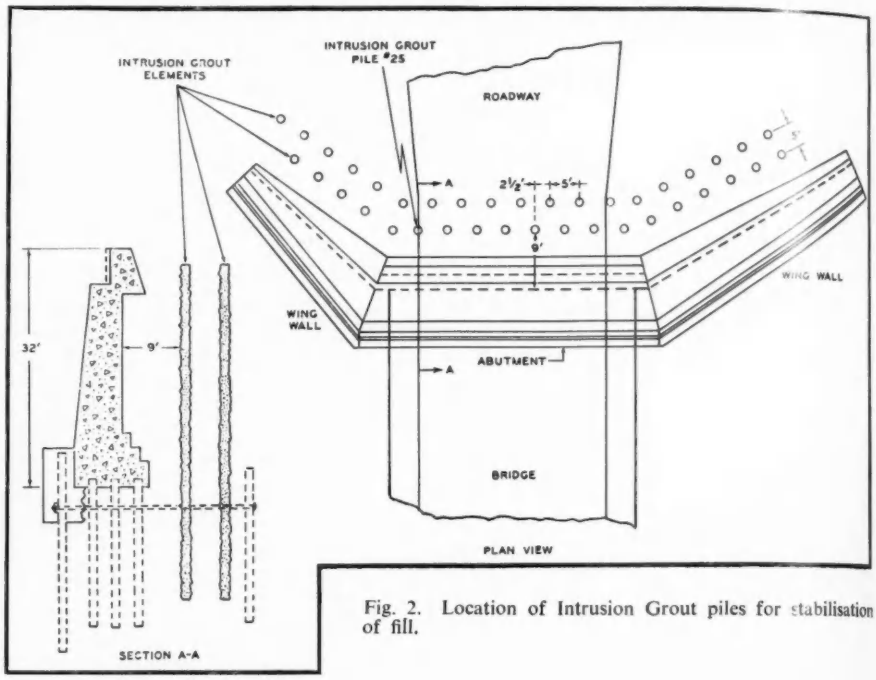


Fig. 2. Location of Intrusion Grout piles for stabilisation of fill.

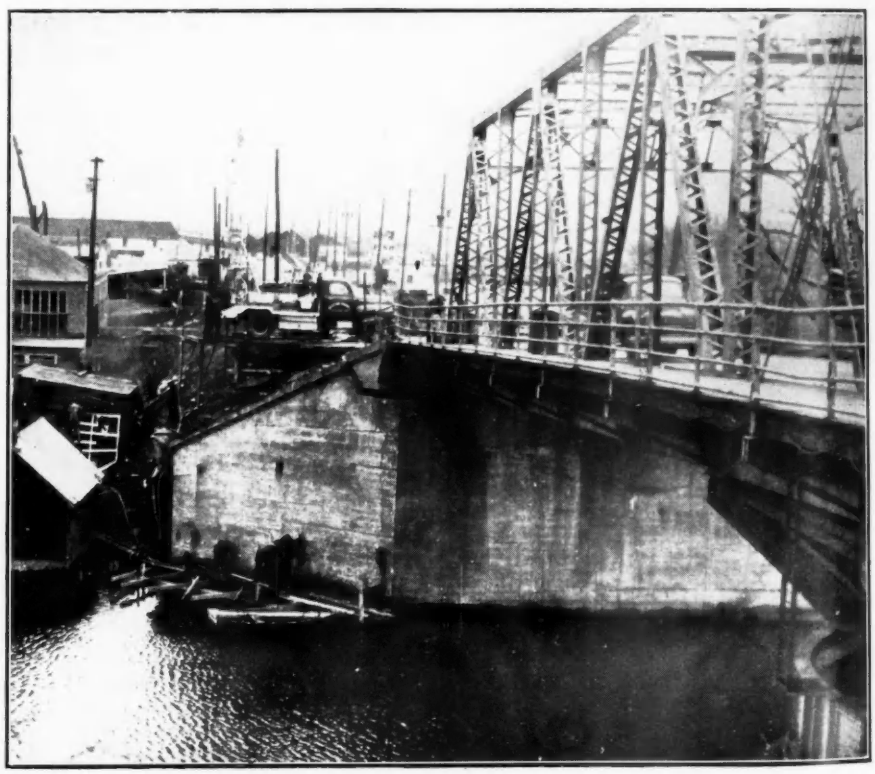


Fig. 3. General view of bridge abutment showing fracture due to pressure of loose sand fill.

Support piling. At Anniston, Alabama, the elements were used in place of driven bearing piles for a pump foundation. A

Intrusion Grout Mixed-in-Place Piles—continued

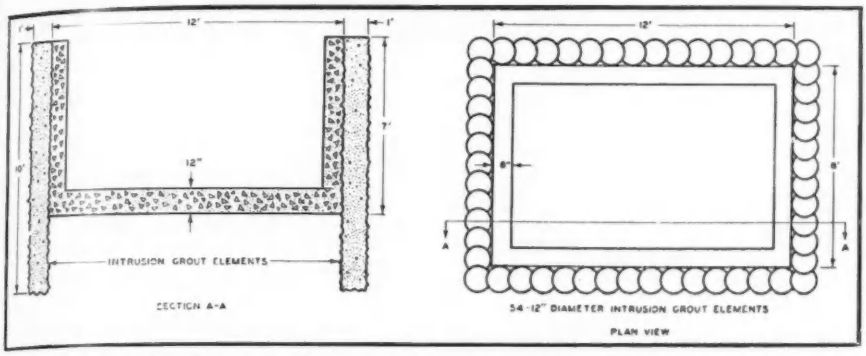


Fig. 4. Intrusion Grout mixed-in-place piles used as a cut-off wall for street excavations.

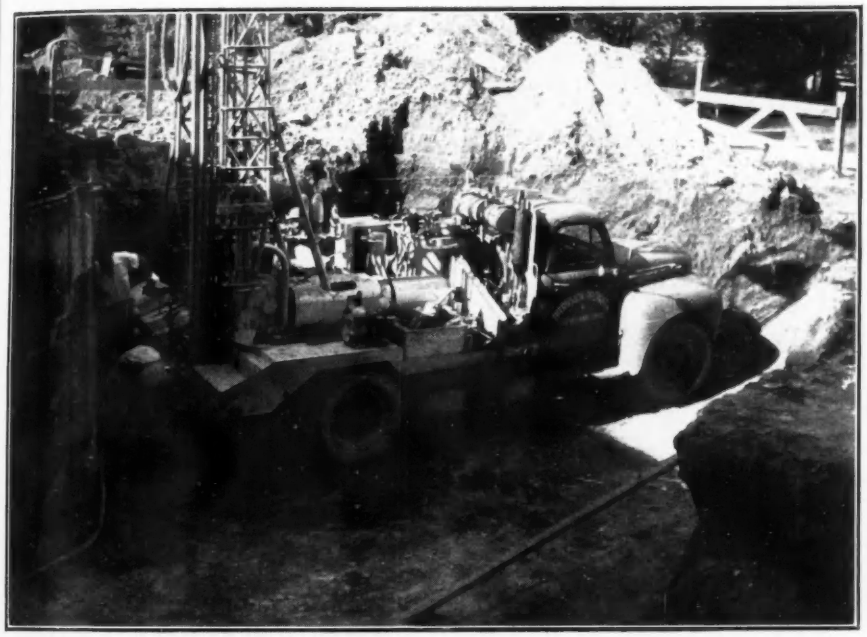


Fig. 5. Self-contained mobile Intrusion-Prepakt unit carrying drilling, grout mixing and pumping equipment at work in close quarters.

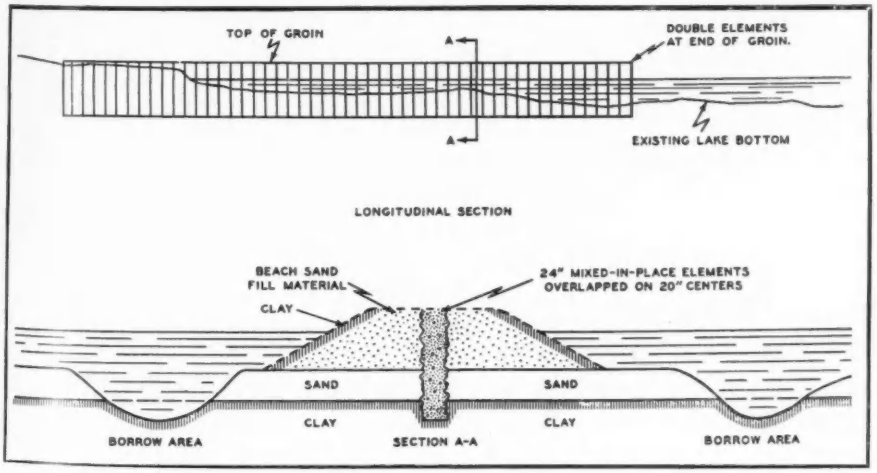


Fig. 6. Breakwater embankment built in Lake Erie with mixed-in-place piles drilled through centre of sand fill.

deep excavation revealed the presence of a flowing sand typical of the Piedmont region. There were strong objections to driving because of the possible damage by vibration which might be done to a flowing spring 30,000,000 gal./day, which was adjacent to the pump foundation. Fig. 5 shows the equipment working in close, crowded quarters. In addition to carrying the load, the mixed-in-place elements tightened up the loose soil and filled voids laterally, as well as vertically.

Jetty. Another application was at Camp Perry, Ohio, where the elements were used as groins to prevent beach erosion in an experimental program. The construction procedure used was to build up a roadway for a distance of approximately 120 feet projecting into the lake by using a clam shell for the mixing rig to operate on. These elements were 24 inches in diameter and from 8 to 10 feet in length. The experimental groin was constructed on an overlapping basis by placing the elements on 20-inch centres, as shown in Fig. 6. Steel reinforcing was placed in some of the elements at the off-shore end of the groin. Comparisons will be made to see if this reinforcing is necessary. The groin, including the sand fill, was constructed in 16 hours' working time. The length of the groin from the sea-wall to its outer extremity is 96 feet.

Underpinning. An example of the use of the elements in underpinning occurred in Omaha, Nebraska, where continued settlement was damaging a building. Fig. 7 shows the foundation wall with its spread footing. The truck-mounted rig was backed against the building so that the drill rod was against the outside of the footing. A 24-inch bit was used which allowed 10½ inches of the blade to work under the footing, providing an area of 190 square inches of support. The elements were placed to a depth of 20 feet below the footing. Two 3/4-inch steel reinforcing bars were used in each element to assist in taking shear and bending in the column. In addition, Intrusion grout was pumped around the footing to prevent any outward movement and to tie it to the elements.

Navy test. At a demonstration for the Bureau of Yards and Docks at the Philadelphia Naval Base, three 58-foot, 12-inch elements were placed in the soft soils which are prevalent in the area. No serious difficulty was encountered in penetrating a hard-pan of cobblestones found between the depths of 43 and 48 feet. The Intrusion grout mix used was 3 bags cement, 1 bag Alfesil and 18 to 20 gallons of water, or a water-cementing materials ratio of 0.48. After two months, these three elements were loaded in increments of approximately 31 tons, 32 tons and 55 tons making a combined load of 118 tons. The settlement at the end of four days averaged less than ¼ of an inch, which is well within the allowable settlement for building foundations of the New York City Building Code.

Retaining wall. Mixed-in-place piles were used as a retaining wall and as a foun-

Intrusion Grout Mixed-in-Place Piles—continued

dation for an addition to the Pacific Telephone and Telegraph building in Renton, Wash. In constructing this addition it was necessary to use piling to a depth of approximately 25 feet to secure adequate footing. Due to the proximity of surrounding buildings, it was deemed inadvisable to drive piling. Also, along the south side of the addition an 8-foot deep cable vault was constructed next to a two-storey masonry building whose footings were only 16 inches below the surface. To avoid damaging the existing buildings by vibration from the pile driving operations and undermining of the footings due to caving, the mixed-in-place technique was used.

Along the south side of the building, 14-inch elements were drilled on 12-inch centres, providing an overlap of the piles. The wall was placed to a depth of 10 feet with every third pile extending to approximately 28 feet to provide bearing. Centreline of the piling was 12 inches from the existing building. Most of the piles were reinforced with one-inch steel bars placed after withdrawal of the mixing head. Piles within the foundation area were cut to grade after excavation and prior to placement of a pile cap. Overlapping piles along the existing building were used as the outside form for, and became an integral part of, the finished basement wall.

These piles were mixed-in-place in a poorly consolidated, sandy, silty gravel with a maximum size of three inches. The strength of a six-inch cube from these piles was 4,397 p.s.i. at 28 days.

Cofferdam wall. At Swedish Hospital, Seattle, 12-inch Mixed-in-Place piles were placed tangentially along a 62-foot length and reinforced with used steel rails. The piles varied in length from 25 to 32 feet, and were left in place as the outside form for the building wall. The excavated cofferdam, strutted with steel joists is shown in Fig. 8.

Summary.

The mixed-in-place procedure and its application is still in its infancy, but sufficient experimental and practical work has been done to warrant wider use on actual jobs. It offers a number of advantages over driven pile methods. Vibration and heaving of the surrounding area due to displacement of material is non-existent so that there can be no damage to nearby structures or adjacent piles. The skin-friction between the elements and the surrounding soil is higher because of the numerous shelves created by the rotating mixing blades and because of the penetration of the grout into the voids and fissures in the surrounding soil. The elimination of setting shrinkage and the slight expansion during setting increases the bond between the elements and the soil.

Mixed-in-place piles can be placed in many sands and gravels which cannot be penetrated by timber or precast concrete piles

By overlapping the elements, a tight cut-off wall may be created thereby eliminating the need for excavation, dewatering, possible shoring, and backfilling. The presence of water has no harmful effect in this type of work. Overlapping elements may also be used in place of sheeting for excavation. When so used, the elements may be applied as the outside form reducing the volume of excavation to that within the perimeter of the structure and eliminating the backfill that would otherwise be required outside the new walls.

When used for underpinning, the mixed-in-place pile can be located so that almost half its cross-sectional area is under the footing. This reduces the quantity of excavation and casting a pile cap to connect the elements with the footing.

Many clays and muds can be stabilized through the use of mixed-in-place elements to prevent lateral movement and to increase bearing power. Such stability as may be inherent in the material is not destroyed as there is no remolding effect from displacement.

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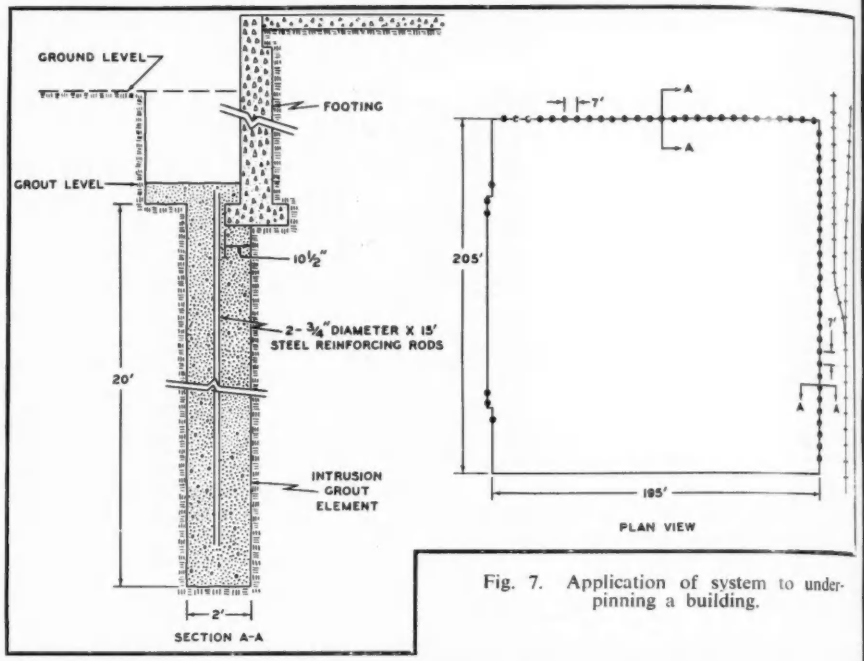


Fig. 7. Application of system to underpinning a building.

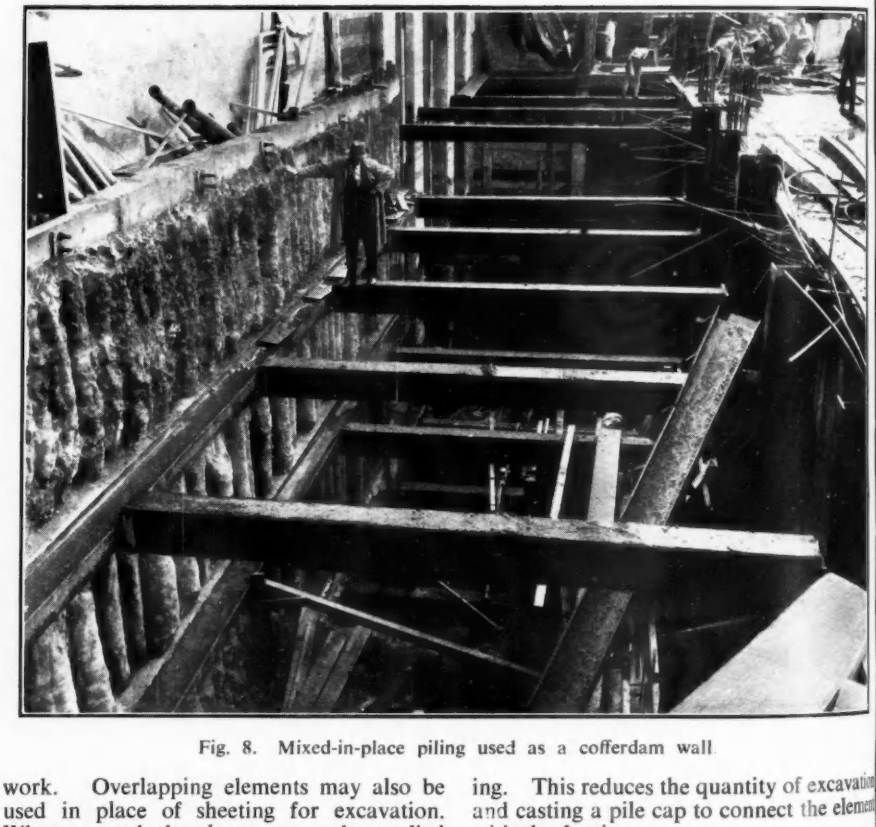


Fig. 8. Mixed-in-place piling used as a cofferdam wall

Development of Inland Waterways

Need for Economic Realism*

By W. FRASER, M.Inst.T., Assistant Managing Director, General Lighterage (Holdings), Ltd.

The Track.

BRITISH inland waterways and canals do not assume the importance which they attain on the Continent of Europe. Their vertical rise per mile is much greater in Britain—10-ft. per mile as against 1.8-ft per mile on Continental waterways—and necessitates a multiplicity of locks. But copious supplies of water are not always available to enable large locks of standard dimensions to be built on all waterways. Hence, unlike the railways, the tracks lack that uniformity of gauge which would permit craft starting at any point in the country proceeding without transhipment to any other point.

Up until 1947, 23 separate navigations were owned by independent undertakings, and 35 belonged to the principal Railway Companies.

Inland waterways are more akin to the roads than the railways: for while a railway owns its track and sidings and operates its own rolling stock, until 1947 the navigations were owned by companies which, with three exceptions, did not supply the craft which traded on them. The navigations existed by the tolls which they collected from the carriers and their responsibility was to maintain the waterways.

Committees of Enquiry.

It has long been recognised that divided control of waterways was one of the principal obstacles to an improvement in their efficiency. All the Committees which have reported to the Government from time to time on the general policy to be adopted in regard to inland waterways have uniformly recommended the amalgamation of those waterways which form parts of through routes. Each of the reports of these Committees has been more precise and more positive than the one before in its proposals for such consolidation; but in no instance was it proposed that the navigation authority as such should embrace the activity of the conveyance of goods for hire or reward.

So long ago as 1872 a Joint Select Committee recommended that the utmost facilities should be given for the amalgamation of adjoining inland navigations with one another. The report of Royal Commission on Canals and Inland Navigation of 1907/9 recommended the consolidation into four groups of those waterways which form the principal routes from the Birmingham area to the four ports of London, Hull, Liverpool and Bristol. The Ministry of Transport Committee on Inland Waterways, which sat in 1921 under the Chairmanship of Mr. Neville Chamberlain, urged that a start should be made without delay with the consolidation of the waterways in the Trent Basin under some form of public control. The Royal Commission on Transport of 1930 recommended that, failing voluntary amalgamation within a short period, the Minister of Transport should take steps to set up Public Trusts which would acquire such canals as it would be in the national interest to preserve and improve.

Reasons for Amalgamation.

The reasons which have led these Committees to their uniform recommendations for amalgamation may be summarised as follows

(i) The divided ownership of a through route, with varying gauges of locks, bridges, widths, draughts and standards of maintenance resulted in inefficiency of working and restricted the whole route to the maximum size and tonnage of craft which navigated the narrowest or the worst maintained section.

(ii) Efficiency of maintenance is increased when amalgamation establishes a body able to command adequate engineering services and special plant and to make these benefits available for all the constituent navigations.

(iii) The divided ownership of the waterways delayed improvements, sometimes urgently required, because owners of one section of a waterway did not, in general, improve their own section of a route unless they were sure that owners of the remaining sections were prepared to improve their own lengths to the same standard; nor have the owners of one waterway spent money readily on the improvement of their length of a route if most of the resulting benefit was likely to accrue to the owners of other sections.

(iv) The financial and commercial interests of different ownerships were not always harmonious. Through tolls and rates were not so general nor so low as would be expected with a unified ownership. Few carriers operated throughout the whole length of a route, there was no regular service from end to end and little attempt was made to attract through traffic.

War-Time Control and Amalgamation.

During the latter part of the Second World War, the Government took control of the Inland Waterway undertakings and to a modified extent unified direction was effected. By virtue of the Transport Act, 1947, these undertakings passed direct from Government control to the British Transport Commission. Thus the aspirations of many Government Committees and Royal Commissions were more than accomplished for the Act created a body to which was transferred the ownership of practically all inland navigations, and in this respect went perhaps further than the regional grouping proposals involving adjoining waterways as advanced by the various Committees and Commissions of Enquiry. In any event the 1947 Transport Act set the scene for a progressive programme of development of the waterways.

At the same time the Commission found itself the possessor of a fleet of barges, for on the transfer of the various navigations there also passed the ownership of the fleets of barges belonging to certain of the independent undertakings. Since 1947 the Commission has extended its carrying interests and it now owns rather less than one-third of all the craft operating on the inland waterways, and rather more than one-fifth of the total carrying capacity of such craft.

Traffics Conveyed.

Up to the year 1905 the annual toll-paying traffic carried on the inland waterways was increasing, and in that year amounted to forty-two million tons. Subsequently it diminished until in 1926 the tonnage was thirteen millions, at which level it was fairly well maintained until 1939. Partly owing to the diversion of shipping to west coast ports, traffic then declined until, as the war ended, the annual carryings were about ten million tons; since 1945 these have gradually increased annually and in 1953 reached twelve and

*Reprinted from a lecture delivered at a Course on "Capital Developments in Inland Transport" held at Ashridge College, Berkhamsted, Herts, September, 1955.

Intrusion Grout Mixed-in-Place Piles—continued

Acknowledgments.

Some of the tests and studies described in this paper were made in connection with work performed for the Bureau of Yards and Docks of the Navy Department in the U.S. Naval Civil Engineering Research and Evaluation Laboratory, Port Hueneme, California, and the demonstrations carried on at the Philadelphia Naval Yard.

The process for mixed-in-place piles and equipment for doing the work were developed and are patented by Intrusion-Prepakt, Inc., Union Commerce Building, Cleveland, Ohio. Edmund Nuttall, Sons & Co. (London) Ltd., 22, Grosvenor Gardens, London, S.W.1, England, is licensee.

Development of Inland Waterways—continued

three-quarter million. The traffics comprise coal, coke, agricultural produce, building materials, liquid fuel, general merchandise and all such commodities as are heavy and bulky and the speedy delivery of which is not essential.

Commission's Waterways.

The English system of navigable waterways, vested in the British Transport Commission, covers 2,000 miles, of which 1,000 miles allows the passage of narrow non-estuarial boats with a beam of 7-ft. and carrying a maximum load of 30 tons per boat; the remaining 1,000 miles permits the passage of estuarial craft of about 14-ft. beam or more and carrying from 65 to 400 tons per vessel according to draught available. These two categories of navigable waterways with their differing physical characteristics must be clearly understood when considering proposals for the development of the entire system.

Narrow Canals.

The narrow, artificial canals connect with the main navigable rivers but they experience difficulties from time to time in obtaining adequate supplies of water for the passage of boats—in summer due to drought and in winter due to ice formation. Narrow canal boats do not and cannot operate with safety on the estuaries.

The Commission's responsibility is nominally for 1,000 miles of narrow canals but 320 miles are not now in commercial use and 200 miles have been formally closed or abandoned. Thus about 480 miles are actually used for the conveyance of goods.

Advantage of Narrow Canals.

These narrow canals fulfilled an essential function in internal transportation up to the advent of the railways. Originally they were highly successful financially, for at the time of their construction the economic superiority of traction by water over traction by road was overwhelmingly great. A horse might move one ton of traffic over 20 miles of roadway in a day; thus the driver had 20 ton-miles to his credit. On the canal, however, the horse moved 25 tons over a distance of 30 miles daily, so that the canal boat had to its credit 750 ton-miles, and if the crew consisted of two men, the ton mileage per man per day was about 19 times as much as that in the case of the horse-drawn vehicle. Clearly until the railways arrived, the canal was an attractive proposition. Subsequently many of these waterways came compulsorily into the possession of the Railway Companies and although half-hearted attempts were made by their new owners (for which little criticism should be levelled against them) to comply with statutory obligations as to maintenance and depth of water, gradually nearly all railway-owned narrow canals fell into desuetude while the independently owned narrow waterways existed precariously alongside their more powerful and modern competitors.

Current Disadvantages of Narrow Canals.

Despite the fact that the motive power of narrow canal boats is largely by motor engine nowadays they cannot in general compete with the road transport motor vehicle. A diesel lorry, manned by one man, can carry 15 tons over a distance of 150 miles in the course of a day, thereby having 2,250 ton-miles to its credit. On the other hand, a pair of narrow boats, one towing another, with a total cargo of 55 tons requires a crew of two and the average distance covered in a day is 35 miles, thus yielding a ton mileage of 960 per man, which is less than one-half of the motor vehicle performance. To attempt wholesale widening and deepening of such waterways and the enlargement of their locks cannot be advocated seriously as the cost would be prohibitive and water supplies would be insufficient to permit continuous navigation. Certain portions of them which form parts of through routes could be improved; and, due to special local conditions, other sections will continue to be used—but the commercial future of the inland navigations of England rests with the wide boat waterways which do or can pass estuarial boats.

Sentiment should not be allowed to interfere with the progress of science. These narrow canals are losing the Commission about £400,000 per annum. The money spent in maintaining them far outstrips the meagre revenues accruing from tolls. The deficit can be utilised to good advantage in developing and improving those waterways which are of commercial value to the nation and which cry out for rehabilitation.

Estuarial Navigations.

The vital inland waterways follow the valleys of the four main rivers of England — the Severn, Thames, Yorkshire Ouse and Trent. These have important ports and harbours at the seaboard ends and great industrial centres along their courses. Their chief function is to relieve and feed the docks. They may, in fact, be regarded as "elongated docks" for their outstanding characteristic is their ability to pass estuarial craft. They are reasonably well equipped with locks and other works enabling large capacity estuarial craft to navigate right into the heart of the country, where extensive terminal accommodation exists to enable traffic to be forwarded to places more remote from the ports by road vehicles, rail wagons, or narrow canal craft.

The British Transport Commission's responsibility is for 1,000 miles of broad navigations, but 130 miles are not now in commercial use and 50 miles have been formally closed or abandoned. A good portion of the remaining mileage is capable of extensive commercial development for there are relatively few water supply difficulties which cannot be overcome. Furthermore, these waterways can pass estuarial craft, and are producing now a profit to the Commission of £300,000 per annum.

Use of Small Craft in Ports.

From time immemorial ocean-going ships have used small boats for the discharge of their cargoes. This procedure was rendered necessary originally because proper quays and docks were not available and ships had to lie at anchor off shore in safe and protected harbours where the only possible means of loading and discharge was through the medium of the ship's own derricks, direct overside to estuarial craft. In the course of time expensive harbour accommodation was constructed and to recompense the capital employed therein and also to ensure adequate maintenance of works and equipment, dock dues were imposed on ocean-going ships. The heavy incidence of these dock dues and rent has created an inducement to arrange the turn-round of a ship in the smallest possible time.

It is a fact that vessels are turned round more speedily and a far greater tonnage is handled per day when loading or discharge is made to estuarial craft and to quays simultaneously. While the permanent equipment on the quayside is engaged in unloading goods to land and to barges moored under the bow and stern, the ship's own derricks are employed in a like operation to estuarial craft moored on the off-shore side of the vessel. Congestion on the quay is minimised and costs are reduced.

For work in the ports these estuarial boats have natural advantages of their own as compared with other forms of inland transport. They have the ability to load and unload goods at steamers without the use of the wharves or unloading gear at the docks, or even in an emergency without the necessity for a ship to go into docks at all. Having been placed alongside a steamer, only three small movements of craft are necessary before loading or unloading is completed. Such movements occupy only a few minutes and are effected by slackening or tightening mooring ropes where either end or middle hold of a boat is worked. In the case of average general merchandise cargo, 45 tons is held in each end and 70 tons in the middle of the hold of a typical estuarial boat and, therefore, at least 45 tons of cargo can be loaded without a break for movement of transport. On the other hand a railway wagon at the port holds on the average seven and one-half tons, and after this quantity has been handled some delay may occur whilst another wagon is shunted into position. Similar delays occur likewise when motor vehicles are used. Furthermore, the actual handling, including stowing, of the cargo is a more speedy operation in estuarial boats for there is ample room for men to keep out of danger and adequate space for the cargo to be easily manipulated, whereas on the restricted platforms of rail and road vehicles great care must be exercised especially in lowering goods.

All these considerable advantages are exploited at present in most of the great ports of England, but the full saving in costs is not achieved because far too many of the estuarial boats, when

Development of Inland Waterways—continued

loaded, are moved but a distance of a few yards in the same dock, or at most a few miles to another dock where the cargo is discharged again to rail trucks or road vehicles for ultimate despatch inland. Yet it is the natural and more economical procedure for the small craft to be despatched inland intact, if only the navigations had the capacity to absorb them. In one sense cities like Leeds, York, Sheffield, Nottingham, and Stourport should be regarded as at the extremities of long extended arms of the docks of the ports with which they are connected by water, the river craft acting as dock lighters.

Economic Benefits Over Road Transport.

In the case of traffic destined for Nottingham, to collect and convey by boat from Hull a consignment of 600 tons from a steamer, four vessels are required, manner by a crew of nine men. On the Trent navigation such a train of estuarial vessels—a power boat towing three dumb barges with an aggregate crew of nine men—can carry 600 tons of traffic over a distance of 70 miles in a day, thus giving a performance of nearly 4,700 ton-miles per man per day, which is double that of a modern 15 ton diesel lorry. In so far as engineering works can allow larger vessels to operate over that waterway, a still greater tonnage can be carried in the same time with no increase in the existing manning strength required for the flotilla.

Thus this typical inland waterway shows a much more efficient movement than road transport and the same advantageous position does or can exist on most of the wide boat estuarial navigations in England.

Improvements Since Amalgamation.

Certain substantial measures in effecting improvements have been taken by the British Transport Commission since 1948, and these were set out in the Report of the Board of Survey of Canals and Inland Waterways presented in November, 1954, and published in April, 1955. They are summarised as follows:

(i) The Commission delegated its responsibility for the docks and waterways to a separate Executive (later replaced by the Docks and Inland Waterways Board of Management).

(ii) Divisional Waterways Officers were appointed with wide powers of management of local business, and the commercial organisation was strengthened in order that additional traffic might be secured.

(iii) Dredging has been undertaken on all the main waterway routes, together with maintenance of banks and towing paths. Where necessary work was put out to contract. New methods of dredging have been introduced; for instance, on the Severn the practice was to deposit dredgings at points in the river where there was an adequate depth of water. This was found to be unsatisfactory and plant has now been purchased to enable the material to be pumped ashore. At other waterways where conditions permit, increasing use is being made of draglines.

(iv) Additional dredging craft and mechanical appliances needed for maintenance purposes have been purchased.

(v) New workshops have been built on the Trent at Newark and Nottingham, and a similar scheme is projected on the Leeds and Liverpool Canal at Wigan. At other places mechanisation has been extended and working conditions improved.

(vi) Among the larger schemes carried out are the construction of a new and larger lock at Newark-on-Trent and the removal (in conjunction with the Trent River Board) of the Holme Flood Lock which had hitherto prevented the passage up-river of the larger type of craft, including petroleum tankers proceeding to the depots in the vicinity of Nottingham. On the Severn, improvements have been carried out at Diglis Basin, near Worcester, to accommodate petroleum craft, and a number of bends on the river which were dangerous to navigation have been removed.

(vii) In addition to the undertakings transferred under the Transport Act, the merchandise-carrying business of Canal Transport Ltd., the Severn Carrying Co. Ltd., Fellows Morton & Clayton Ltd. and several large barges operated by the Government on the Severn, including the warehousing and terminal facilities belonging to these bodies, were acquired. On certain of the waterways new craft have been brought into service, some of which have been constructed of high-tensile steel capable of carrying a greater payload than those made of the traditional materials.

(viii) Additional cranes and handling appliances for traffic have been provided.

(ix) A research organisation has been established.

These various measures taken by the Commission since 1947 may be commended but they only touch the fringe of the problem. Much more vigorous and positive action is required and is no doubt in contemplation.

Economic Prospects of Waterways.

The "Conclusions and Recommendations" of the Board of Survey divided the waterways into three categories according to their economic prospects:

(1) Waterways to be developed.

(2) Waterways to be retained.

(3) Waterways having insufficient commercial prospects to justify their retention for navigation.

Waterways to be Developed.

The waterways to be developed totalling 340 miles embraces the estuarial navigations flowing to the Humber, the river Weaver, the river Lea below Enfield Lock, the Grand Union Canal to Berkhamsted, and the estuarial Severn waterways. This conclusion is sound because these waterways already carry substantial traffic and offer scope for further development. The Board of Survey states that they should be improved by the elimination where necessary of accumulated arrears of maintenance, by dredging, bank protection and other improvements which would presumably include, where necessary, the provision of new locks or the enlargement of existing ones. Such work will, of course, involve heavy expenditure but in the view of the Board of Survey where economic justification exists, such expenditure should be undertaken.

Waterways to be Retained.

In the second category of waterways to be retained, the Board of Survey names canals and navigations having a mileage of 990. The Board considers that these navigations under existing conditions appear to be worth retaining for transport purposes either by reason of the tonnage of traffic upon them or because they form part of a through route. The Board states that they should be maintained for the present to an adequate standard of efficiency and every encouragement should be given to the development of traffic. The Board further recommends that if it becomes apparent in the light of further experience that the retention for transport purposes of any of these waterways is no longer justified, they should be transferred to the category of waterways having insufficient commercial prospects to justify their retention for navigation.

Waterways to be Abandoned.

In the third category of waterways, the Board of Survey lists canals and navigations having a total mileage of 770, but some 500 miles have already been formally closed to traffic or abandoned. Competent opinion will agree with the Board's conclusion that the remaining 270 miles should cease to function as commercial navigations. The waterways in this category involve at present a dead loss of £200,000 per annum.

Current Development Proposals.

The British Transport Commission has now had an opportunity of examining the report of the Board of Survey, and has already announced a "first small instalment" of major schemes for the development of Britain's inland waterways.

It is significant that the whole of the expenditure envisaged is concerned with the trading or carrying activities of the British Transport Commission rather than the direct physical improvement of the tracks. Some £90,000 is to be spent on improving terminal depots at Nottingham, £22,000 on powered carrying craft and £40,000 on re-building and expanding a depot at Hull. It is

Development of Inland Waterways—continued

also proposed to spend £230,000 on a 28-acre waterside site about a mile from Leeds and a further £115,000 on buying nine new craft and increasing the cargo-carrying capacity of four existing barges. As far as the North West is concerned, £67,000 is to be spent on new workshops at Wigan on the Leeds and Liverpool Canal.

Relief for Carriers.

It will be observed that no specific scheme has been determined for improving the track and no help is accorded to the substantial and prepondering independent contractors who operate on the waterways.

The carrying organisations have put propositions to the Commission involving schemes which will afford improved navigations enabling speedier turn-round of craft to be effected and larger carrying units to be operated. It would seem to be reasonable that the Commission should in the first instance apply themselves to carrying out these proposals rather than spend large sums of money on the provision of additional terminal accommodation which will undoubtedly mean keener competition with the independent carriers and little benefit for them by way of more economic working.

Improvements of Trent Navigation.

Throughout the years prior to 1947, the independent undertakings responsible for the operation of the Trent Navigation spent large sums of money in improving that waterway and following each improvement effected, traffic responded not as a result of pre-determined action by the navigation authorities but on the initiative of the carriers concerned to take advantage of the improved waterway. As has already been mentioned, since 1947 the Newark Town Lock has been replaced by a new and larger lock capable of penning four boats instead of one as previously. In conjunction with the Trent River Board, the Holme flood lock which has hitherto prevented the passage upriver of larger type of craft, has been eliminated.

These works have improved unquestionably the capacity of the navigation, reduced transit time and enabled larger carrying units to be employed. But the present carrying capacity of this navigation may now have reached its maximum and additional tonnages for conveyance, while on offer to the carriers, may prove impossible to carry not through lack of boats or adverse freight rates but through the physical incapacity of the navigation to pass more vessels through a bottleneck which exists at that point where the first lock has to be negotiated.

This first lock is met when proceeding from the Humber at Cromwell, five miles below Newark. Severe congestion of traffic occurs at this point where in the summer months the movement of craft is restricted by the rise and fall of the tide. Each neap tide, when the river is at summer level, fully laden craft are unable to pass into the lock except by the use of a third pair of gates which have been built below the lock. This procedure causes delay through double locking and also by restricting the penning to two boats at a time. At spring tide in the summer months craft drawing 6-ft. can only pass through the lock in one pen by arriving at or about the time of high tide.

An hydraulic survey shows that a further lock and weir below Cromwell although helpful in deepening the water below the lock, would not provide adequate depth of water over the lower sill of the present lock. It is therefore urgently necessary that a new four-boat lock with adequate sill depth be built, duplicating the present Cromwell lock. Additionally a shortening of a bend in the river immediately below this lock would also improve the navigation at that point.

These proposals would not cost the sum of money which the Commission propose to be spent on improving the terminal facilities at Nottingham and on purchasing additional powered carrying craft. It is exceedingly difficult to understand why the Commission have come to the conclusion which they have publicised, for it may well be that the traffic on the Trent navigation has now reached saturation point and can increase only if the waterway is improved. Hence the expenditure contemplated of £90,000 on terminal depots at Nottingham and £22,000 on powered carrying craft may prove to be quite uneconomic.

These same arguments apply to other navigations, and it is suggested that the prime activity of the Commission should be a thorough survey of the physical condition of the estuarial navigations with a view to their immediate improvement. The position is analogous in all respects to the necessity for the provision of up-to-date efficient motor roadways.

Carrying Services.

The ownership of the waterways now vested in the British Transport Commission is a natural monopoly. It is exceedingly doubtful if the carrying services, which have always been operated in the main by a considerable number of owners of small and large fleets, is an activity suited for State enterprise.

The Commission's control has proved to be rigid in administration and inflexible in operation, and these attributes may not be dis-advantageous to the ownership and provision of an efficient track. On the other hand, the waterway carrying trade requires the attributes of private enterprise—healthy competition between carriers, quick decisions, speculative enterprise, progressive development and a driving urge to solicit new business.

In the year 1933 the British Transport Commission incurred a deficit of £47,000 on their carrying activities. The only activity showing a surplus was coal-carrying, mainly by compartment boats on the Aire and Calder Navigation, which had a surplus of £54,000. The loss on other carrying operations thus amounted to £101,000. Nearly £50,000 of this loss resulted from the operation of narrow canal craft, which, it is feared, must increase in the future owing to the economic inability of such craft to compete with road transport. Also, manning difficulties are now acute.

It is suggested that the Commission might be well advised to sell or let to independent carrying agencies their carrying undertakings other than those concerned with the operation of narrow canal boats which will have to be abandoned in due time. If this be accomplished, losses would be eliminated, the waterways would be available to carriers and traders alike, and the prime object of the Commission could be " service " not " profit."

Toll Charges.

The position of the waterway carrier (usually termed the " bye-trader ") is in some respects analagous to that of the road haulier in that he operates on a highway over which he exercises no control and in which he has no financial interest. But whereas the haulier pays an annual licence fee for the right to use the highways for his vehicle, irrespective of the tonnage carried per annum, except for the incidence of the revenue tax on fuel used by road vehicles, the waterway carrier is obliged to remit to the Commission a toll on every ton conveyed by boat. The larger the annual tonnage carried by a road vehicle the smaller is the licence cost per ton, but the inland waterway carrier's toll per ton does not vary whether he conveys 1,000 tons or 10,000 tons per annum. The carrier is greatly burdened by the heavy contribution which he has to make in the forms of tolls and dues to the Commission, which is often not less than 25 per cent. of his total receipt.

The present method of levying toll charges on a carrier should be cancelled and the contribution required from him towards the expense of his track should result from the charging of a suitable annual licence fee for each boat. Thus a strong incentive towards increased work and efficiency on the part of the carrier would be provided and control could be exercised by the Commission to ensure that boats are maintained in good and efficient repair.

Conclusions.

The prime objects, therefore, of the Commission must be the speedy and progressive improvement of the estuarial navigations; the elimination of unhealthy and unfair competition between the carrying services of the Commission and those of their best customers, the bye-traders; a revision of the basis of levying toll charges on carriers and traders; and the closure of uneconomic narrow canals.

There is no doubt whatsoever that the existing capacities of the estuarial navigations can be increased substantially. There is plenty of evidence that improved tracks will secure increased traffics, especially tonnages emanating from or proceeding to the ports. Any steps which will quicken the turn-round of ocean-

Development of Inland Waterways—continued

going ships will benefit the entire community and increased loading to and from estuarial craft offers the best and perhaps the only active positive and immediately practical panacea towards that end.

When such estuarial craft are in motion, the community receives still greater benefit in so far as craft start or finish their journeys in the heart of the hinterland. Congestion on the nation's highways is increasing daily. Any relief which can be afforded to keep traffic off the roads should be encouraged provided costs are not inflated in the process. Estuarial inland waterways are affording substantial relief now and can, with improvements, make a still greater contribution.

Road traffic congestion in London is wasting millions of pounds annually. Road vehicles are kept waiting at the docks owing to physical inability to handle goods. If a vastly improved waterway from London to Berkhamsted were created, streams of vehicles could discharge and load shipping goods at that point, thereby reducing substantially the number of vehicles passing through the Metropolitan area; while flotillas of barges would silently and efficiently pass in safety to and from the docks. Such an arrangement would make for lasting national good and it is in such directions that thought should be focussed so as to use the river highways which represent a rich endowment by nature.

Appropriate capital developments can create vastly improved navigations which, in their own sphere, are inherently the most economical form of transport for the community. They require no highly expensive surfacing of track, neither road materials nor steel rails—as in the case of land—to support their vehicles of transportation. Neither do they demand, as does the air, continuous momentum or chemical agency to support that which is heavier than itself. The average English waterway passing estuarial craft, costs less to maintain per mile than a first class road or a main line railroad. On a navigation there is a lower resistance to haulage, a less amount of dead weight hauled and a greater degree of safety for cargoes carried.

While road transport continues to extract an appalling toll of human life and limb annually, and accidents involving loss of life do take place on the railways, deaths resulting from the movement of goods by inland water transport are exceedingly rare. In calculating the value to the community of all forms of transport, surely considerations of this kind must also be taken into account.

Repairs to Skerryvore Lighthouse

Skerryvore Lighthouse stands on an isolated rock about 60 miles west of Oban, Argyllshire, and 11 miles south west of the island of Tiree in the Inner Hebrides. It was built by Alan Stevenson (an uncle of R. L. Stevenson) for the Commissioners of Northern Lighthouses in 1838-44. The structure is built of granite masonry throughout and is 150-ft. in height with a diameter at the base of 42-ft.

On the night of 16th March 1954, a severe fire occurred and gutted the tower. The staff of lightkeepers fortunately escaped and, the weather being calm, they spent the night on the rock and were taken off by a relief vessel on the following day.

The light itself was completely destroyed, and the masonry of the tower was damaged, mainly due to the mica content of the granite swelling in the intense heat. Externally there were some cracks right through the thickness of the wall, and internally the walls and ceilings of the chambers showed much flaking and spalling of the granite surface. Some of the damage at the top of the tower was due to blast from the fog signal charges exploded by the conflagration.

During the summer of 1954, first aid repairs were carried out by the Lighthouse Board Staff. Ceilings were shored up, and the building made reasonably watertight; rubble was removed and new ladders put in. The lantern was renewed, and an automatic light was installed, so that the Lighthouse could operate unattended in the winter 1954-55.

Meanwhile various proposals for the permanent repairs were considered and tenders were invited. In January 1955, the scheme put forward by Whitley Moran and Co. Ltd., of Liverpool was adopted, and immediate preparations for the work began. The internal walls of the lighthouse rooms were to be repaired by cutting out all damaged granite and replacing it with gunite. The domed ceilings were to be restored by forming thin gunite domes on the underside. No steel reinforcement was to be used owing to the danger of corrosion. The cracks in the tower were to be filled up by pressure grouting with neat cement. It was necessary to take down and rebuild any portion of the masonry.

The execution of the work offered certain difficulties. The rock on which the lighthouse is built lies in a large area of shoal water, and the approaches are somewhat hazardous when there is any swell and impossible in bad weather. There is no beach or landing stage of any kind. The site is exposed to the full force of the

(Above). Interior wall of lighthouse where fire damage had been most severe. All spalled and flaky granite has been cut out, up to a maximum depth of 11-in.
(Left). Skerryvore Lighthouse on completion of the repairs.

Repairs to Skerryvore Lighthouse—continued

North Atlantic gales and the surface of the rock is liable to be swept by surf at highwater. There was thus no sheltered place on the rock where plant can be set up and materials stored without risk of loss. The only accommodation available for men was in the lighthouse itself, where the rooms were not watertight and the quarters were intended to house not more than four men.

It was decided to divide the work into two main phases, viz. the preliminary works and the permanent repair works. The preliminary works included the construction of bases to receive a crane and compressor house; the supply and erection of a 3-ton hand crane, specially designed so that it could be transhipped in small components and put ashore from an open boat; the provision of a steel compressor hut designed like the deck house on a ship, and built up of small units; the erection of a small timber landing stage and various minor works. The crane and compressor house were supplied under the main contract. The bases and erection were carried out by Messrs. D and J. McDougall of Oban during the period March-May 1955. Bad weather delayed the operations on several occasions for a week at a time, when it was impossible to land equipment on the rock.

The permanent repair work comprised the guniting and pressure grouting works referred to above and these were put in hand in the end of May 1955. The internal gunite work was completed first, taking full advantage of the good weather during the months of June and July. The external guniting and pressure grouting work followed. This work was carried out from suspended cradles, with the aid of steeplejacks supplied by Messrs. Dixon and Mills Ltd., Liverpool, and was completed by the end of August.

The gang on the rock numbered seven in all, six contractor's men (all specialists) and one Lightkeeper who acted as radio operator and cook. Oban was the main base of operations, with an advance base at Hynish in the Island of Tiree, where there is a small pier. Sea transit of men and equipment has mainly been carried out by the Northern Lighthouse Commissioners' ship m.v. "Hesperus," whose ship's company possess unrivalled local knowledge of these waters. A small coaster was chartered to take out the main contractor's heavy plant in May; for the day-to-day supply of materials, provisions and mail from the base at Hynish to the Rock, a motor fishing boat was chartered from Mull. It will be understood that each landing was in doubt until it had been successfully achieved, and this applied particularly to putting ashore the heavy plant including air compressor, cement gun and grouting equipment.

Communications presented some difficulty throughout. There was an existing R/T link between the lighthouse and the Commissioners' radio station at Oban, but this involved the transcription and relaying of messages and sometimes led to delay and confusion. As a result arrangements were made to link the R/T from the Rock to the G.P.O. Marine R/T system at stated times, and it was then possible to speak to the men at the rock direct from headquarters in Edinburgh or Liverpool. For local communications V.H.F. radio telephone apparatus was installed in the lighthouse, on the service fishing vessel and at the Hynish base, so that advantage could be seized for the landing of supplies when wind and sea conditions permitted.

On the completion of the structural repair work at the end of August, the long spell of calm weather broke, and some weeks of bad weather followed, accompanied by high winds and heavy ground swell. The temporary landing stage was swept away and the crane slightly damaged. The removal of the contractor's plant and men was a matter of difficulty, and had to be carried out by stages, making opportunist use of short spells when the seas moderated. During this period it had not been possible to maintain the provisioning of the Rock at a normal level.

The last load of plant was successfully taken off in mid-September. The Lighthouse was then put in trim for the winter and a six months' supply of acetylene gas in cylinders was installed. The station will now operate unattended until next spring.

Whilst the operations themselves were on quite a small scale, the exposed nature of the site resulted in the physical problems being out of proportion to the size of the works.

Cargo Handling Exhibition at Antwerp

I.C.H.C.A. Display and Symposium

An exhibition of cargo handling equipment organised by the Belgian National Committee of the International Cargo Handling Co-Ordination Association was held at Antwerp from September 19th to 24th, 1955. Herein were shown representative examples of mobile cranes, fork-lift trucks and straddle carriers, mechanical loaders, and numerous other items of handling gear. In addition to the static exhibition in a large shed, there was provided a large adjacent open space in which mobile gear was demonstrated.

At the same time, advantage was taken of the presence of visitors from a number of countries to hold a Symposium on the Training of the "Black-Coated Port Worker."

Emphasis was given to the importance of clerical and administrative workers having a good education, which was both wide in its scope and highly specialised in all aspects of port and shipping work. Mr. H. Verhulst, Adjunct-Councillor to the "Direction Générale" of the Port of Antwerp, drew attention to the special position of Antwerp as one of the major clearing houses of European imports and exports, and emphasised the need for a steady supply of qualified recruits in the shipping business and in port administration. Mr. Verhulst also drew attention to the special institutions which had in recent years been established in Antwerp for the training of the technical and administrative personnel needed by the maritime, commercial and financial enterprises of the area.

This theme was further developed by Mr. J. Luyckx, President of the Professional Institute for Port Employees, who, after reviewing the frustrations in the way of the ambitious port worker in the days of his youth, went on to say that soon after the 1939-45 war the Antwerp Shipping Federation and the Union of Antwerp Forwarding Agents realised that something must be done to overcome the shortage of clerks possessing sufficient professional knowledge. Accordingly the Professional Institute was formed, training courses were organised and instructional literature prepared and issued. There was now a three year course in which the subjects ranged from the study of languages and the calculation of freights to the intricacies of insurance and the general average.

The Rev. Fra. A. Taymans, Director of the Institut Supérieur de Commerce Saint Ignace, spoke of the importance of university training. In all aspects of business there was one common feature —that the business man was an intermediary to bringing men together, and most of all in the shipping world, because transport within a port linked many human interests including producers, bankers, consumers, marine insurers, port workers, Customs officers, etc. Experience and technical training were not of themselves enough to prepare a man for a leading position in a business concern and particularly in the maritime business world. The nature of shipping work required that a man who was to take ultimately great responsibility should have a wide, humanistic appreciation of commercial, political and economic affairs far beyond the horizon of the port in which he worked, and for this reason the university trained recruit to shipping, would, while initially knowing less about the technicalities of his job, in the end prove to be the better executive.

Dr. F. Camerlinckx, Director of the Institut Supérieur de Commerce de l'Etât, wound up the Symposium by pointing out that the two Institutes were the first in Belgium and probably in Europe to cater for students of commerce at university level. Among the subjects of maritime interest in the curriculum were national and foreign fleets, merchant ship types, shipbuilding, shiprepairing, port administration and equipment, marine insurance, Customs, cargoes and the structure of trade unions and employers' organisations both in Belgium and abroad.

The Hopper Dredge

Its History, Development and Operation

A Review of a Publication by the Office of the Chief of Engineers, U.S. Army.

IN an earlier article the functions of the United States Corps of Engineers in regard to maritime works were briefly outlined, and mention was made of their responsibility for the development and conservation of navigable waters. For nearly a century the Corps has been building and operating dredgers to assist in carrying out this work, and in 1954 the Office of the Chief of Engineers, Major General S. D. Sturgis, produced under the direction of the Hopper Dredge Board and the editorial supervision of Mr. F. C. Scheffaur, an account of the history, development and operation of the hydraulic, hopper suction dredges* which are now the main equipment used by the Corps in discharging this responsibility.

Because of its comprehensive and detailed treatment of the subject and its distillation of decades of valuable experience, this publication must be considered as a major contribution to the literature of dredging. A brief notice would not do it justice, and consequently this series of articles will take the form of a detailed precis including quotations and illustrations from the work. Grateful acknowledgment is made to the Corps of Engineers, U.S. Army, for permission, readily given, to review the publication in this way.

The Hopper Dredge Board was constituted in 1944 and in 1947 it was directed among other things to "recommend policies and general features of design for hopper dredge construction." The Board has participated in the design of five new dredges, culminating in the well-known "Essayons," the largest of its type in the world. In a preface to the volume, Mr. C. G. Giroux, Chairman of the Board, defines the purpose of the work as to "trace the development of . . . . . the seagoing Hopper Dredge, to describe in some detail the improvements which have been made in its design, construction and operation, and to point out some of the mistakes that have been made." The last mentioned purpose is as valuable as it is unusual.

The hopper dredges, as used by the Corps of Engineers, are seagoing vessels built to satisfy "Ocean" classification. They operate free in the water, moving while working, at a ground speed of 2 to 3 miles per hour, with trailing dragarms, and discharging into built-in hoppers. They range from 180-ft. to 525-ft. in length and from 500 to 8,000 cubic yards in hopper capacity.

History and Development.

It is possible that the "General Moultrie," of whose existence in the United States in 1855 there are records, was the first hydraulic hopper dredge. Built of wood, and 150-ft. long, her dredging machinery consisted of a large centrifugal pump, 6-ft. in diameter, to which was connected a 9-in. iron suction pipe. She was followed in 1871 by the "Henry Burden," a converted side-wheeler, and in 1874 by the "Woodbury" and together those vessels established the basic soundness of the principle of suction dredging. In 1885, the "Howard," of 350 tons and equipped with a 12-in. centrifugal pump and two 9-in. side suction pipes was privately built. The vessel assisted in the first major project performed by hopper dredges in the United States, namely the dredging of the Gedney Channel in New York Harbour, 28-ft. deep, 1,000-ft. wide and 4,000-ft. long, after other methods had yielded unsatisfactory results.

In 1899, a 40-ft. depth in the Ambrose Channel, New York, was authorised. The private contractor built two self-propelled hopper dredges of the "Liverpool" type, each equipped with a 48-in. pump and a single suction pipe. These dredges, which depend on the bed material running to the pipe nozzle, although successful in the Mersey, were not so in Ambrose Channel. The work was eventually taken over by the Government who built four self-propelled, side drag-arm hopper dredges, two with 2,500 cubic yard hoppers and two with 2,880 cubic yard hoppers, with which the Channel was completed in 1914.

Between 1901 and 1910 the Government authorised the construction of seventeen hopper dredges. One of these, the "Chinook," which was built as a freighter in 1892, was converted by the Corps in 1903, and with a hopper capacity of 4,050 cubic yards, was the largest and fastest hopper dredge in the United States, until the "Goethals" was built in 1937.

Since 1910, twenty seven hopper dredges have been built or acquired by the United States. In all, the Corps have operated fifty-two hopper dredges of which twenty were on the active list in 1952. All of these were or are side drag-arm vessels with the exception of two stern drags and four centre drags. The "Culbera" is of historic interest. Engaged in dredging the Panama Canal, she was the first large vessel to navigate through it. Subsequently she rounded Cape Horn, and was the first vessel completely to circumnavigate South America.

The "Goethals" built in 1937, was the first hopper dredge to have high-pressure steam, turbo-electric power. In the same year, the "Pacific," built for shallow draft operations, and carrying 300 cubic yards of sand at 9-ft. draft was the first dredge to have two side drag-arms connected to a simple dredge pump.

Between 1940 and 1950 six 700 cubic yard shallow draft dredges and four 3,000 cubic yard dredges were built in addition to the 8,000 cubic-yard "Essayons." The shallow draft vessels are diesel-electric powered and have two side drag-arms with a single pump. The 3,000 cubic yard dredges are turbo-electric powered, and have two side drag-arms and two pumps. The "Essayons," which was built especially for operations in New York Harbour where all material must be deposited in deep water outside Sandy Hook, is similarly powered and equipped, but her drag-arms, which are fitted with trunnion side plates, may be raised and stowed on deck.

All modern dredges have twin screws and rudders for superior manoeuvrability.

Developments in design have yielded greater hopper capacity and speed and improved manoeuvrability. In the last two decades, older and more obsolete dredges have been replaced, and it has been found possible to reduce the total number of units. The fleet currently numbers nineteen.

In 1949, twenty hopper dredges of the Corps of Engineers excavated and disposed of 110,000,000 cubic yards of material (measured "in situ") at an average unit cost of 13.2 cents per cubic yard.

Corps of Engineers' Preference for Hopper Dredges

It is natural that the authors of a work of this nature, who have themselves been intimately involved in the development of the modern hopper dredge, should be enthusiastic about its characteristics as compared with dredges of other types, and early in the book there is listed a number of its advantages. Among these are its mobility, not only on a particular dredging site, but between widely separated sites; its versatility; and the fact that it does not obstruct navigation, as does a dredge which requires mooring lines. It is claimed to be the only type of dredge able to work effectively, safely and economically in waters exposed to the open sea. Its obvious disadvantage, which is not mentioned specifically, is that while it is transporting its load to the depositing site and returning, it is not dredging, and its costly dredging equipment is idle. In fairness to the authors, however, it must be stated that, taking this "lost time" into account, with the conditions generally encountered in the United States, an overall economy is claimed for the hopper dredge—as compared with other types of dredges.

An examination of the reasons why, in Europe, the bucket ladder dredge has tended to predominate (although, of course, suction dredges are built and operated) whereas in the United States, except as a mining tool, this type has had comparatively little use since the construction of the Panama Canal, does not come within the scope of the book, but would undoubtedly prove interesting. In

*Throughout this review the terms dredge and dredges are used instead of dredger and dredgers more common in Europe.

Hopper Dredge—continued

the opinion of the Reviewer, one reason probably lies in the fact that in Europe the material to be dredged is frequently cohesive; clay or soft rock. Although a bucket dredge, of course, can handle less cohesive materials, it is perhaps less efficient in certain types of soils than a suction dredge. A second reason is that, in Great Britain at any rate, dredging is generally carried out by Harbour Authorities responsible for a particular area. The work can be planned far ahead in detail so that the dredge will be in use for a high proportion of its working life. Thus a comparatively expensive and highly specialised vessel can be economically employed.

In the United States, the less cohesive bed materials are more common and the enormous area over which the responsibilities of the Corps of Engineers extends, requires a very versatile and mobile type of equipment. Where more resistant materials are met with, cutter heads, or, very infrequently, blasting techniques are used.

Wartime Work of Hopper Dredges.

During World War II, United States Army dredges displayed their ability to operate under European conditions with excellent results, and from several examples that are quoted may be instanced the work of the dredge "Marshall" which removed a shoal consisting of cobblestones and gravel from Dundee Harbour, and the dredges "Harding" and "Hoffman" which carried out maintenance dredging in the Mersey and the Ribble. The dredges also carried out valuable work in France and Germany.

It was, however, in the Pacific Ocean Theatre that the major wartime contribution of the hopper dredge fleet was made. Here, eight dredges engaged in widespread and often dangerous operations amply demonstrated their efficiency, mobility and versatility.

Fundamentals of Hopper Dredges.

Hopper dredges are fundamentally self-powered hoppers into which pumps discharge a mixture of water and bed material sucked through pipe lines lowered through the water and resting on the bed. They are of three main types, classified by the arrangement of the suction pipe. In the manual under review this is referred to as a "drag-arm." It terminates at the top in a trunnion connected to the ship's hull, and at the bottom in a suction-head, which is referred to as a "drag-head" or "drag." The three types are the side-drag, the centre-drag and the stern-drag.

The side-drag dredge may have two drag-arms, one on either side, connected either to one or two pumps, or a single drag-arm. The drag-arm is suspended outwards from davits. Ball joints may be fitted in the drag-arm to give angular movement. In the latest dredge "Essayons," specially developed trunnion assemblies permit the drag-arms to be raised to deck level if desired (Fig. 1).

The centre drag-arm type has a well, running longitudinally amidships, in which a structural steel drag-arm supporting a suction pipe is supported by an "A" frame.

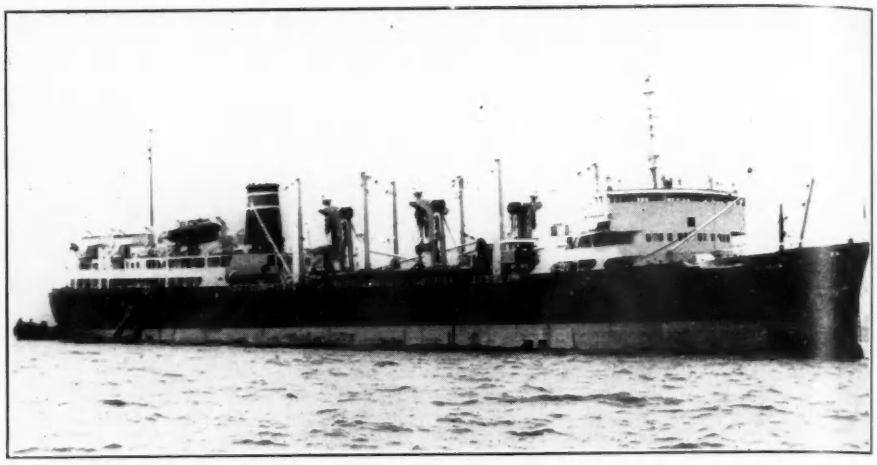


Fig. 1, Trunnion assemblies of the dredge "Essayons."

The pipe is connected to a pump through a heavy trunnion. Hoppers are located on either side of the well.

Finally, the stern drag-arm dredge, of which there is only one in the United States, is illustrated in Fig. 2. This type, which was once common in Europe, was developed by Otto Fruehling and has been fully described by the late Dr. Chatley†.

The Corps' dredges are designed as ocean-going vessels in accordance with the regulations of the appropriate authorities, with propulsion power to work and travel in rough seas, powerful dredge pumps, modern navigation equipment and comfortable crews' quarters.

Certain criteria are specified for the hull and superstructure. These amply indicate the thought that has been given to the problem and are quoted in full:—

(1) It should be constructed with ample strength and with such proportions as to enable it to operate in rough seas without excessive pitching, and to navigate safely between ports in stormy weather.

(2) The hull dimensions should provide ample lateral stability since heavy list will occur should the hoppers on one side only, dump their loads inadvertently.

(3) The loaded draft should be held to a minimum, thus adding to the general adaptability of the dredge.

(4) The freeboard should be adequate to ensure dry decks when operating.

(5) Its stern should be of the counter type to prevent overtopping by steep waves or breaking seas on an exposed ocean bar. The stern keg should be cut away to provide superior manoeuvrability, but not enough to cause yawing of the vessel while moving with and in a following sea.

(6) It should have bilge keels or rolling chocks to steady the ship when operating in a seaway.

(7) It should have twin propellers and twin rudders for optimum manoeuvrability. The propellers should be large in diameter and relatively slow turning. The rudders should be larger than normally required in a commercial vessel of like size.

(8) It should have the hopper space located amidships, and hopper slopes not steeper than required for dumping the bulk of materials dredged. The hopper space should be sub-divided into a number of independent hoppers to enable partial loading of dredge at lesser draft when work demands such procedure. The hopper dump doors or valves, when closed, should offer minimum friction resistance. Hopper capacity should be provided for loading the dredge to its designed load draft with material weighing 125 pounds per cubic foot. Overflow troughs for hoppers should be arranged athwartship. The main power plant should be aft of the hopper space and the dredge pump room forward of it.

(9) Spectacle framing for the twin propeller tail shafts should be provided in lieu of struts when practicable. If not, the strut hubs and arms should be extra large in cross-section since these parts are subjected to considerable erosion. In addition, the strut hubs should be connected firmly to the end of the stern tube flange by a halved steel tube to add stiffness to the strut.

(10) Fuel and water tankage, refrigeration capacity and storeroom space for equipment, stores and supplies should be adequate for transoceanic voyages.

(11) The bridge structure, including pilot house, should be only high enough to ensure good visibility forward and aft. The camber of the pilot-house deck should be held to a minimum and windows arranged to provide, as far as practicable, an unobstructed view in all directions.

(12) In order to obtain unobstructed view aft, smokestacks should be narrow in athwartship direction and lifeboats so suspended as to give minimum interference. Foremasts should be light in

†See "The Dock and Harbour Authority," Vol. XIX, August 1939.

Hopper Dredge—continued

weight and placed on top of, instead of directly in front of, the pilothouse.

(13) Quarters should be located on and above the weather deck as far as practicable. Recreational rooms and facilities should be provided because off-watch members of the crew are unable in many localities to leave the dredge. Mess and sanitary arrangements must be first-class quality. Duty on hopper dredges is in many respects more arduous than on passenger or freight vessels, because the deck officers and crew not only must be constantly on the alert navigating the dredge, but also must operate and care for the dredging equipment. Likewise, the engine room crew is required to operate and maintain dredging machinery in addition to the other regular ship machinery.

(14) Since dredges may be required to work in tropical waters, adequate ventilation systems are necessary.

Regarding machinery and controls it is recommended that large dredges requiring highpower be provided with steam turbines, medium and shallow draft dredges with diesel engines. But either type of prime mover should operate through an electric motor drive. The practicability and ease of controlling such motors from the pilothouse are regarded of the greatest importance. The propulsion power must be adequate to permit dredging at a ground speed of 2½ miles per hour with an opposing current of 5 miles per hour. The dredge pump, winches davits and other auxiliary equipment are generally electrically powered.

In considering the capacity of the pumps, special consideration must be given to the available hopper surface area for stilling the discharge, and steps must be taken to provide cast steel or special alloys in those parts most subject to wear and abrasion.

For drag-arms without sliding trunnions, two support davits are provided, one at the ball joint having an outreach of about 8-ft., and the other for the drag-head with an outreach of 10- to 15-ft.

In a number of dredges gas-removal units have been installed, and recently, in a few vessels, systems for unwatering the hopper have been provided.

OPERATION

Before proceeding to discuss in detail the hull, superstructure, pumps and auxiliary equipment, a very interesting chapter is included on general operating matters and technique. Bed materials handled are classified under four headings.

(a) **Mud, Silt and Clay.** Of the materials under this heading, silt (grain size from 0.002 mm. to 0.02 mm.) probably presents the greatest difficulties, because of the comparatively long time it requires to settle out of suspension. Various techniques may be employed including allowing hoppers to overflow with the dredging pumps operating slowly. This, in fact, means utilising the hoppers as stilling ponds. Another method is to unwater the hoppers before pumping is commenced, pump at full power whilst dredging, and stop the pumps when overflow starts.

Where gas is present in the mud, it will reduce the suction and the pump efficiency. Some dredges are, therefore, fitted with gas removers.

(b) **Sand, particularly very fine sand** (grain size 0.05 mm. to 0.01 mm. can present difficulties. When firmly compacted, close bottom contact of the underside of the drag is essential to obtain a satisfactory intake of material. Once thrown into suspension, very fine sand settles but slowly and presents difficulties similar to silt. Also, when the grains are angular the material tends to arch in the hopper and impede discharge.

Loose, coarse sands present no difficulties.

(c) **Gravel,** in which the grains vary from 5 mm. to 64 mm. (2½-in.) is readily dredged by suction dredges. Stones above 64 mm. are termed "cobblestones." The maximum size of stone that can be handled is limited by the size of the openings in the drag-head grating, and other parts of the hydraulic system. Gravel, mixed with sand and clay and densely compacted is difficult to excavate by hopper dredge without blasting or using a special gate.

(d) **Coral** presents problems due to its extreme abrasiveness and solid coral requires prior blasting. A special drag-head, known as the "coral-drag" has been developed.

The techniques required to deal with various types of bed material have obviously received long and careful study. With mud, mud and sand, mud-silt mixtures and loose sand that flows readily, the best ground speed has been found to be about 2 miles per hour. With fine compacted sand the speed is increased to 2½ to 3½ miles per hour so as to reduce the relative intake of free water.

Agitation dredging is resorted to in some circumstances. This technique is used with fine sands and silt when it is difficult to obtain a full load. The dredged material is allowed to overflow the hoppers and advantage is taken of tidal and other currents to disperse it into areas where deeper water exists.

The disposal of the dredged material follows well established lines and mention will only be made of the use of rehandling basins, where, as in the Delaware River, suitable dumping grounds are scarce. The material, deposited by the dredge in the basin, is subsequently pumped ashore.

Dredging surveys also follow the usual pattern, the standard equipment including the echo-sounder.

HULL AND SUPERSTRUCTURE

It is in this and subsequent chapters, in which are given the general principles underlying the design of modern hopper dredges, together with detailed examples and ample illustrations, that the work under review is particularly valuable. Because of the concise nature of the writing it is not possible to give a precis of the subject matter in the space available without omitting much that is important and interesting. It should be made clear that where omissions of pertinent matter are noted, the fault is most unlikely to be in the book under review, which is most comprehensive and well balanced, but rather in the need occasioned by the nature of these articles to select topics.

In dealing with design of the main hull girder, it has been found in the case of the "Comber" and "Essayons" class dredges that the required section modulus is between 40 to 66 per cent. in excess of those required by the empirical formula in the relevant regulations. This is because the hopper load, taken at 125 pounds per cubic foot for design purposes, is concentrated over a comparatively short length, resulting in higher bending moments than would be found in commercial vessels.

The necessary openings in the strength deck obviously create problems. In the "Essayons" where wide hopper spaces and heavy loads created a serious problem in developing longitudinal strength, the hopper side bulkheads were continued for half the length of the dredge or more, and formed part of the main hull girder, thus increasing the amidships section modulus.

Hopper dimensions affect strength, stability and trim, and they require careful study. It is desirable to have hoppers as long as

Fig. 2. The stern drag-arm dredge "New Orleans."

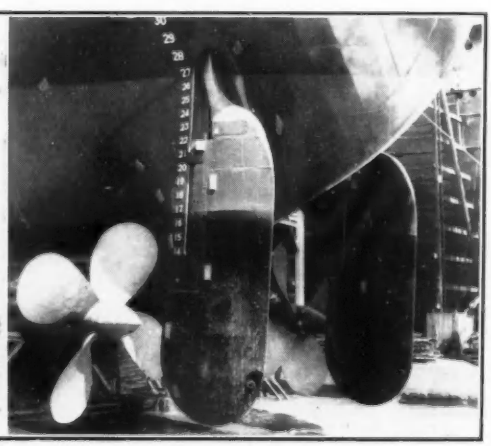


Fig. 3. The hull form, rudders and screws of the "Essayons."

Hopper Dredge—continued

possible so as to distribute the load over a considerable length of hull girder and thus reduce the bending moments. It has been found that for dumping materials, hopper slopes of between 40° and 60° are desirable.

Model tests have been made from time to time to obtain data on power and speed, hull shape and manoeuvrability. The effect of shallow water, which can be tested in a model, is interesting and important. For the "Essayons," it was determined that in a channel 42-ft. 6-in. wide by 27-ft. deep, the power requirements at full speed were 45 per cent. greater than in deep water, representing a difference of 1.4 knots.

Resistance set up by the drag-arm, hopper doors, rudders, etc., have a considerable effect on the design. In the "Essayons" it was found that the rudder resistance was least when the rudders were set at an angle of from 3° to 4°. In earlier dredges the resistance caused by the drag-arm sponsons and stays was great, amounting in the "Goethals" to 60 per cent. of the bare hull resistance at full speed. With increasing speeds, this design aspect required careful consideration and in model tests it was found that by removing the stays and streamlining the trunnion elbow, the resistance of a 30-in. drag-arm would be reduced by as much as 54 per cent. at full power.

Full hull forms are suitable for hopper dredges, block coefficients being in the range from 0.68 to 0.81. It is advantageous from the point of view of resistance to have a parallel section in the hull preferably somewhat forward of midlength, the optimum length of parallel mid-body being between 20 and 30 per cent. of the vessel's length. This simplifies construction and enables hopper doors to be designed for interchangeability. The midship section, for simplicity, must be nearly rectangular with flat bottom and side plating and a radius at the bilge. With the exception of "Goethals" and "Essayons," length to beam ratios are lower than normal, being as low as 4.42 in smaller dredges, and being influenced by stability requirements and draft limitations. Because of the need to reduce rolling, bilge keels are provided.

In the most recent dredges, cruiser type sterns have been adopted, having been found to have propulsive advantages in twin-screw design over elliptical or fantail sterns.

In considering the materials to be used, parts which will be called upon to resist abnormal wear or abrasion are made easily replaceable and use is made of cast nickel-chromium-molybdenum, cast carbon molybdenum, and various special steel alloys. Draft is reduced by use of lightweight steel alloys, aluminium etc.

Stability, Draft and Trim.

Although the two-compartment subdivision of ships did not become obligatory until 1948, the "Pacific," built in 1937, was so divided. The Corps of Engineers have adopted this practice in all recent dredges other than those which are so small that such a sub-division would be too restrictive.

The stability of a dredge is a function of the relative positions of the metacentre and the centre of gravity. In hopper dredges this relationship is affected by conditions not obtaining in normal ship design, viz. the varying conditions of one or more hopper doors opened or closed. The effect of free water surface is also more complex. In the case of hopper dredges the free water surface of the fluid material in the hoppers must also be considered. This fluid is normally denser than water, and it is found that a density of 90 lb. per cu. ft. provides a reasonable margin of safety in stability considerations.

In the last resort however, the maintenance of the vessel in a stable condition depends on the master, who must ensure in loading, that the material is distributed among the hopper compartments so as to avoid unstable conditions. In discharging, it is possible that the hoppers along one side will empty quickly, whist those on the other may fail to do so. It is not feasible to provide sufficient stability in a loaded dredge to withstand a heeling movement of the magnitude caused by all the hoppers on one side failing to dump. Sufficient stability can generally be provided however, to withstand at best one hopper remaining loaded with all the others empty. With materials which may jam in the hopper, generally two adjacent athwartship hoppers are opened together; further hoppers not being opened until these have cleared.

Because hopper dredges must be able to operate under as wide a variety of conditions as possible, it is important that their use should not be curtailed by reason of draft, which must thus be as small as possible. This is rendered difficult by the variety and weight of machinery and equipment that must be accommodated. Draft also effects such features as the height of hopper overflow, length of drag-arm, trunnion position, capacity of unwatering pumps and type of of doors. In the "Absecon," designed for shallow draft operations, side doors have been installed, which permit complete hopper discharge if the vessel runs aground.

The "Lyman" class of hopper dredges have been designed so that their hopper capacities can readily be changed from one predetermined amount to another by providing lower and upper overflow levels controlled by sliding gates. These vessels, having a light operating draft of 8-ft. 5-in. forward and 10-ft. aft, and a loaded draft of 12-ft. 5-in. forward and 13-ft. aft, can operate in less than 12-ft. of water, and yet can dredge up to 45-ft. deep. They have also demonstrated their ability to cross the ocean under their own power.

Trim is an important factor, particularly in shallow dredges. The position of the machinery, which may constitute as much as 35 per cent. of the light ship weight is obviously an important factor.

Propulsion Power.

Sufficient propulsion power must first be available to propel the loaded vessel at the required travelling speed, and secondly to propel it at the required dredging speed with the drags in contact with the bed, allowance being made for adverse currents.

Where the propulsion prime movers are independent units, such as diesel engines, the former consideration predominates at the speeds normally selected. Where the prime mover also serves for pumping and auxiliary purposes, as with diesel-electric and turbo-electric installations, sufficient power must be also available for propulsion during dredging.

In considering the resistances to be overcome, the coefficient of friction of the drag on a sand bottom may be taken as 0.25. In estimating the propulsion power required for

Fig. 4. Interior of the pilothouse of the "Essayons."

Hopper Dredge—continued

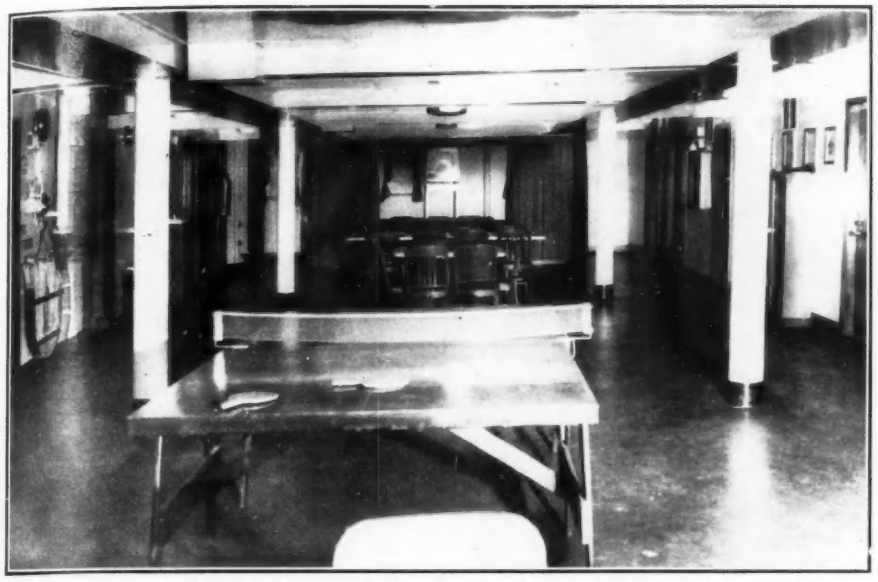


Fig. 5. The crew's recreation room in the " Essayons."

dredging, the increased propeller slip due to the need to overcome high resistance at low speed and the consequent reduced propeller efficiency must be considered.

Propellers and Rudder.

The use of twin screws is regarded by the Corps of Engineers as a necessity, firstly because of the increased manœuvrability gained thereby. Secondly, the screw diameter is reduced, which is advantageous where conditions of full form and shallow draft obtain; thirdly each can operate at higher efficiency than one of restricted diameter designed to absorb full power, and finally, one is available for propulsion should the other be damaged.

In twin-screw ships, twin rudders placed directly aft of the propellers have been found to produce steering forces of greater magnitude than single rudders placed on the centre line, notwithstanding the fact that the combined areas of the twin rudders may not exceed the area of the single rudder. The hull form, rudders and screws of the " Essayons " are illustrated in Fig. 3.

Pilothouse, Crew and Work Spaces.

Dealing with the pilothouse, the publication notes that this " has developed from a small confined space into a comfortable, spacious compartment, equipped with modern instruments, controls and aids to navigation." This is amply confirmed by Fig. 4, which is a photograph of the interior of the pilothouse of the dredge " Essayons." By extending the pilothouse the full width of the vessel with an overhang of 30-in. at either side, an unrestricted forward view is obtained, as well as along the whole of each side of the vessel.

In some dredges, in addition to the normal bridge equipment, engine order telegraph stands are mounted at the outboard ends of the pilothouse as well as the centre. In modern electric-drive dredges, where control is from the bridge, the propeller revolution control is situated near the centre of the pilothouse, and in recent dredges in the bridge wings as well.

It is evident that a very high standard of accommodation is provided for the crew in the Corps' dredges. Fig 5 shows the crews' recreation room in the " Essayons."

Workshops are provided, including a machine shop with a variety of machine tools and welding equipment, an electrical shop, and boatswain's and carpenter's stores.

Miscellaneous Equipment.

There is of course, in each dredge, a wide variety of other equipment, including hoists, cranes, booms, masts, kingposts, boats and davits, anchors, winches, windlasses and capstans to which reference is made in the manual. The review on this section will end with a note on steering gear. The types used in the Corps of Engineers' dredges are electric, steam or electro-hydraulic. The last mentioned has proved most satisfactory and is used in the more modern dredges, electric remote control from the bridge being installed in the latest vessels.

It is considered desirable for close manœuvring for the steering gear to be capable of turning the rudders from hard-over to hard-over in 20 seconds.

(To be continued)

Dock Delays

Motor Vehicle Congestion at British Ports

By R. MORTON MITCHELL, B.L., D.R.A., S.S.C., M.Inst.T
(Chief Executive Officer and Secretary, Road Haulage Association Ltd.)

In recent months greater publicity than ever has been given to the delays caused to motor vehicles at docks. Years ago steps were taken to explore the possibility of obtaining a quicker turn-round of shipping in the ports of the United Kingdom. Lord Leathers, as Minister for the Co-ordination of Transport, Fuel and Power, set up a Ports Efficiency Committee to investigate the working of the ports of the United Kingdom and to secure the co-operation of all interests concerned.

Up to August, 1952, that committee had had 15 meetings and had come to certain conclusions. It advocated the desirability of a system of operational committees in the main ports to collect and collate operating statistics to ensure the most effective use of existing physical resources and to keep the Ports Efficiency Committee fully informed of any difficulties which might be found in regard to the working of the port, which could not be solved locally. Although some such machinery already operated in certain cases it was not of general application, and accordingly the Ports Efficiency Committee recommended that " Port Operations Panels " be set up to carry out the foregoing purposes, mainly, no doubt, on a day to day basis.

These Port Operations Panels were intended to follow closely on the lines of Port Operations Consultative Panels, whose formation were recommended in 1948 in the Report of the Working Party on the Turn-Round of Shipping. It was envisaged that the new Panels would meet regularly, act rapidly and effectively by mutual agreement, and keep themselves fully informed of the state of the ports. Panels were, in fact, set up, or existing Committees reconstituted with revised terms of reference, in certain ports, and in other cases local arrangements were made to meet the position.

In addition to dealing with the operational side of port organisation, it was found that simultaneously attention had been paid to the position of port users. A Central Port Users' Committee had been formed, consisting of the Presidents of the Federation of British Industries, the Association of British Chambers of Commerce, the National Union of Manufacturers, the Chamber of Shipping of the United Kingdom and the Liverpool Steamship Owners' Association. With the encouragement of the Ports Efficiency Committee the Central Port Users Committee proceeded with the formation of a system of Port Users' Committees at individual ports to co-ordinate the " user " interest of ship owners and traders generally.

Dock Delays—continued

Now it is clear that at least in 1952 there was adequate machinery available for dealing with many of the main problems of ports. As a result of the war considerable re-building and modernisation were required, and this has been undertaken in some instances. A factor to which less attention appears to have been given than necessary, has been the increasing use of road vehicles for the transport of goods to and from ships. At times, efforts have been made to rectify the position locally, not always with success. When it is remembered that there are something like one million commercial goods vehicles on the roads of Britain, many operated by traders themselves and another large number operated by road hauliers on behalf of trade and industry, these are to a greater or lesser extent affected by failure to load and unload goods quickly at docks.

Complaints have been made that all docks are not suitable for road traffic, and in some cases road traffic is definitely prohibited because there is just no provision for it. Cases have been quoted in London where vehicles have waited (returning each day) for as long as 5½ days. One instance has been given of a lorry load to the Royal Albert Dock in London arriving on 27th July last and having to wait on 28th, 29th and 30th July. Owing to the holiday week-end the goods were only delivered ultimately to the ship on Tuesday, 2nd August.

It is said that at this dock it is common to have a delay of 24 hours and upwards. In another instance a vehicle arrived for unloading at 6 a.m. on 16th July, but was not unloaded until 3.30 p.m. on 21st July. Yet another vehicle arrived at 6.30 a.m. on 15th July and was not unloaded until 3.30 p.m. on 21st July.

Complaints are made in respect of most of the larger docks at some time or another, depending upon the construction of the dock, the organisation of labour, or the type of traffic handled. For instance, Southampton has been severely criticised on the ground that long distance vehicles have had to remain as much as 5½ days before being unloaded. This appears to be due to some extent to inadequate shed accommodation. However, new sheds are apparently now being built for the Union Castle line, which will allow lorries to load and unload more easily. It has been stated that increase in exports has added to the difficulties of handling at ports, and in some cases the increase in traffic has been very substantial. Much depends upon the nature of the traffic and the facilities available.

The handling of small consignments perhaps destined for different ships almost certainly involves delays as all ships are not prepared to receive goods in the order most suitable to the haulier. Fully loaded vehicles with goods for one ship only have a better chance of being dealt with quickly, but this depends on close co-operation between the trader, the haulier and the dock authority. As an example of the sort of co-operation that is possible among port users I would mention the steps taken by the R.H.A. members in the Metropolitan and South Eastern Area with the very great help of the London Chamber of Commerce to rationalise the collection and delivery of "small" to docks. It is expected that the arrangements for the bulk collection of this difficult traffic will play a useful part in the reduction of dock delays.

In Hull the handling of grain presents problems due to the fact that the silo there can be overloaded. At times ships are said to be standing out of the port merely storing grain until the silo is ready to accommodate it and vehicles can be loaded.

At the beginning of August attention was drawn in the Press to an unhappy situation that arose when the Russian ship "Kalingrad" was being loaded with electrical equipment at Hull. It was stated that about 40 lorries with crated cargo arrived at the quay side and another 40 were on the road; but the rate of transferring cargo to the ship was only four lorries per day. During this time lorry drivers stood around on the quay side in the hot sun. In fairness it was said that in dealing with four lorry loads in one day the dockers were working as fast as the ship's heavy lifting gear would allow. Whether the "Kalingrad" was, in fact, occupying the most suitable berth for the purpose may be doubted. A suitable berth is not always available, but it is of little use expecting quick transfer of goods if a ship occupies a berth that is not fitted with proper facilities. In some cases, of course, a mobile crane could be used, but Dock authorities and others concerned will not always permit hauliers to bring mobile cranes into the dock area.

As was pointed out in the case of the "Kalingrad" the question of the order of stowing cargo may affect the order in which road haulage vehicles are unloaded. However, this could be overcome to some extent by close co-operation between all those concerned with the timing of the arrival of goods at ports. In addition, a greater use of mechanical handling equipment, particularly fork-lift trucks, would ease the movement of goods within the docks.

It would be invidious to make any distinction between conditions at the main ports, as it is true to say that road hauliers generally can find vehicles held up for varying periods at most of the leading ports. The problem, therefore, is to improve the flow of traffic by timing the arrival of vehicles to suit the ship, the organisation of labour, and the availability of adequate handling facilities. The layout of the ports themselves is a major problem, and although in one or two cases more adequate shed accommodation is gradually being provided, the whole problem cannot be solved until much more comprehensive alterations in ports have taken place.

Although elaborate machinery has been prepared for dealing with conditions at docks, information indicates that meetings of Port Operations Panels have not been as regular as was originally envisaged, and it is very questionable whether Port Users' Committees have met at all during the last two years. So far as the general public is concerned nothing has been heard of the Ports Efficiency Committee for some years.

Obviously the ownership of ports throughout the United Kingdom makes it difficult to recommend general principles for facilitating the movement of traffic at ports. Each port is owned by a different type of authority without any uniform set of conditions throughout the country. Accordingly each port presents its own peculiar problems. Size, situation in relation to road and rail facilities, geographical position in relation to access for shipping, and the scope for improvement or development, all require the consideration of those responsible for the present and future management of the ports concerned.

There is a fairly general opinion that, as in many cases ports were constructed primarily to deal with rail traffic, and the increase in road traffic makes many railway lines redundant, the accesses to berths and transit sheds should be re-constructed to meet the needs of road transport. For instance, many docks are totally inadequate for long distance 6-wheeler and 8-wheeler vehicles. In one case in London it is stated that such vehicles having brought goods over long distances may find it necessary to reverse as much as 250 yards in order to turn the vehicle round—quite a difficult job even for an expert driver. Anyone who has driven an articulated vehicle or a tractor and trailer can well appreciate how difficult this can be, especially if the roadway is narrow.

At the recent Conference which was convened by the Road Haulage Association, all the organisations interested in this problem were represented, including Dock Authorities. The Conference agreed to take action to ensure that the maximum use is made of Port Operation Panels and Port Users' Committees. Although it would not be fair to expect Dock Authorities themselves to agree entirely with steps being taken to impel them to be more active in dealing with this problem, it does seem that Port Authorities could be more active in taking a long-term view of the necessity for dock improvements and Port Users' Committees could do much to promote practical steps to avoid delays.

From time to time reliable reports are received of the conditions prevailing at important Continental ports. Besides inciting envy at the comparatively low incidence of delays that occur there, they also show that the port installations and administration have been adapted and improved quite quickly to deal with the increased total flow of goods and the increased proportion of them which are being handled by road vehicles abroad.

I have said that these conditions abroad incite envy. Perhaps they will do more and provide both the incentive and the knowledge by which we in Great Britain shall ensure that eventually some of our new highways will lead to ports that are free from congestion.

The Port Workers' Union, Rangoon

By J. F. SOARES, Secretary, ITF Indian Regional Information Office*

The Rangoon Port Workers' Union founded in 1946 is an industrial union organising all the workers employed by the Commissioners for the Port of Rangoon, including managerial staff. This is an unusual feature for trade unions in the East but evidently such diverse membership has not hampered its activities or weakened its bargaining strength. Included in the membership are: dockers (longshoremen), workshop employees, ranging from "coolies" to the Assistant Mechanical Engineers and, in fact, all employees of the mechanical engineering, marine, salvage, port survey, pilotage, civil enginering, flotilla, and traffic departments. By convention, though not by requirement of its constitution, the only employees not permitted to be members are masters of vessels and the executive heads of thirteen departments into which the "Commission" is divided.

There is no compulsory membership except for longshoremen, who are recruited through the union's hiring hall. Nevertheless, a check-off system prevails and the dues deducted are credited to the union by the accounting sections of the various departments. The dues rate is eight annas (9d.) a month for members drawing under Rs. 100 and one rupee (1s. 6d.) for members drawing above Rs. 100. The existing wage structure though primarily based on the recommendations of a Pay Commission has been recast by collective bargaining whereby a minimum has been laid down, which at present is Rs. 40 (£3) per month for the lowest paid employee. Cost-of-living allowances (minimum Rs. 42) are also payable.

Dockers in the port of Rangoon are divided into two sections: those working vessels in stream, being stevedore-recruited labour and members of the various dock workers' unions; the other section, working on wharves and jetties, being members of the stevedore unions. Of this latter section, a large percentage is on the permanent strength of the Commissioners and is paid on a monthly basis, the present wage rate being Rs. 50 with an addition of Rs. 47 as cost-of-living allowance. When the permanent working force is insufficient to meet the requirements of any particular day, the "casual" section is called in and dockers of this section (all of whom are registered members of the Port Workers' Union) receive wages on a daily basis, at present Rs. 3/10 per working day of 7½ hours. In all the Commissioners' departments, hours of work are regulated, a 44-hour week being worked in all except the dockers, where it is a 45-hour week.

The representative and democratic character of the General Council of the union is made possible by an elaborate election system which works somewhat as follows: the thirteen departments of the Commissioners elect a council of eighty-six. From this council is elected an executive committee of twenty-seven, from which in turn are elected the nine officials or office-bearers of the union. Of the five secretaries of the union, three are in charge respectively of "Organizsation," "Publicity and Propaganda," and "Social and Welfare."

In keeping with the aims and objects of the union, one of which is "to develop the moral, intellectual, social and physical welfare of the port workers," the union's activities are canalized to provide for (a) library (b) a school teaching English, Burmese, Book-keeping, and Accountancy (c) a co-operative consumers' store (d) funds, earmarked for "strikes," "credit," and "death benefits" and (e) an amenities section for hospitalized members.

Consultation machinery between the union and the Commissioners is through a Joint Board, which meets at the request of either party and to which are referred all points of dispute.

An unusual feature, testifying to the harmonious relations existing between the union and the Commissioners, is the fact that the union is provided with free, commodious, furnished quarters within the Commissioners' premises, i.e. in the Commissioners' headquarters building. By regulations laid down in 1947, the union's officials are (a) entitled to recommend or persuade any workpeople to any course of action connected with their work, subject to compliance with the provisions and acts relating to trade disputes (b) at all times allowed to enter any part of the port area without restrictions in order to exercise their rights as union officials and to deal with matters relating to the administration and organization of the union and (c) are to be released from their duties as Commissioners' employees whenever it becomes urgently necessary for them to be so released. Such privileges, unusual in this part of the world, have instilled in the minds of union officials a deep sense of responsibility to their own obligations which are discharged in fairness and justice to employers and members alike, a factor which has conduced greatly to the union's standing and prestige as a democratic and free organization.

*Abstract from a recent issue of the Bulletin of the International Transport Workers' Federation.

Correspondence

To the Editor of "The Dock and Harbour Authority"

Dear Sir,

Genoa Storm Damage.

The storm of 19th-20th February, 1955, caused several breaches along the Galliera breakwater in the Port of Genoa.

We have shown, in a paper entitled: "The undulating distortion of vertical jetties" (which appeared in the French review "Travaux" for June, 1942), that breaches due to the repeated thrust of waves on vertical jetties (as with the Galliera breakwater) should be at a distance of 0.63 x 2 L from each other, with a first maximum at 0.24 x 2 L from the end of the jetty (2 L = the length of the wave).

Now, the waves had a length of about 100 metres on the 19th and 20th February, 1955, in front of the Galliera breakwater, and for 2 L = 98.50 metres the estimates of the reckoning compare with the actual damage as follows (the end of the jetty forming the starting place of the metrical points):

Breaches reckoned Metrical Point	Breaches noticed Metrical Point
24	—
86	80 to 106
148	146 to 156
210	203 to 226
272	281 to 316
334	326 to 343
396	389 to 402

(The absence of a breach at metrical point 24 is obviously due to the fact that at that point the jetty has an appreciable overwidth which forms a jetty-head).

This agreement appeared to us to be of sufficient interest to be pointed out.

Actually, we find in it not only a fresh confirmation of the theory of diffraction that we published in 1942 (with confirmations on the Algiers, Catane and Touapsé protection works) but a fresh confirmation, going beyond our reckonings, of the general theory of the formation of swell in front of vertical jetties, upon which we had based our own.

National Hydraulic Laboratory,
Chaton (S-et-O), France.
28th September, 1955.

Yours faithfully,
J. LARRAS,
Chief Engineer of Bridges and Roads.

Neon Sign for Gravesend Pilot Station.

A large red neon sign has recently been put up at the Trinity House pilot station at Gravesend to give clear indication of its position on the Royal Terrace Pier. This has been done so that at night masters of vessels can see where the pilot station is. In recent years there have been a number of prosecutions in the local court of ships' masters who have broken the pilotage regulations by failing to take on Trinity House pilots for their voyages up and down the Thames. The sign has been put up since one ship's master summoned at Gravesend put forward the defence that he could not see the pilot station after dark.

Cargo Handling at the Commercial Port of Portsmouth

Description of Mechanical Methods Employed

By Capt. R. P. FARRELL, Harbour Master; and
J. C. COTTON, A.M.I.C.E., M.I.Mun.E., A.R.I.C.S., Deputy City Engineer.

GEOGRAPHICALLY, Portsmouth is so sheltered by the Isle of Wight to the south, that, if it is possible for a vessel to make a passage, it is also possible for that vessel to enter Portsmouth harbour, moor at her allotted berth, and discharge or take aboard her cargo.

It has always been realised that, if to this natural advantage speed in cargo handling could be added, the commercial port would possess advantages over many ports of a similar size in the country.

The commercial Port of Portsmouth Harbour consists of the Camber, which is hard by the harbour entrance, and Flathouse Quays, to the north. These two docks are situated to the south and north of Portsmouth Dockyard respectively, and are some two miles distant from each other by road. There is a 13-ft. 6-in. tide range during spring tides and 8-ft. 6-in. at neaps.

The Port is operated by the Docks and Airport Committee of the Portsmouth Corporation, under the Chairmanship of Alderman A. Johnson, and has been steadily developed and provided with up to date facilities over the last 25 years.

There are six working berths at the Camber for general cargo as shown on the aerial photograph (Fig. 1) and four at Flathouse. The layout of the two areas is shown in Fig. 2, and from this it will be seen that, in addition, there is a coaling berth (Berths 9 and 10) at the Camber which is used almost exclusively for discharging coal vessels, although at times granite roadmaking materials and concrete aggregates are discharged. The dock handles an average of two colliers per week which are discharged by overhead cantilevered travelling grab gantries, into reinforced concrete hoppers.

Fig. 1. Aerial view of the Camber.

Types of Cargo.

The port deals with general cargoes, but in particular bulk

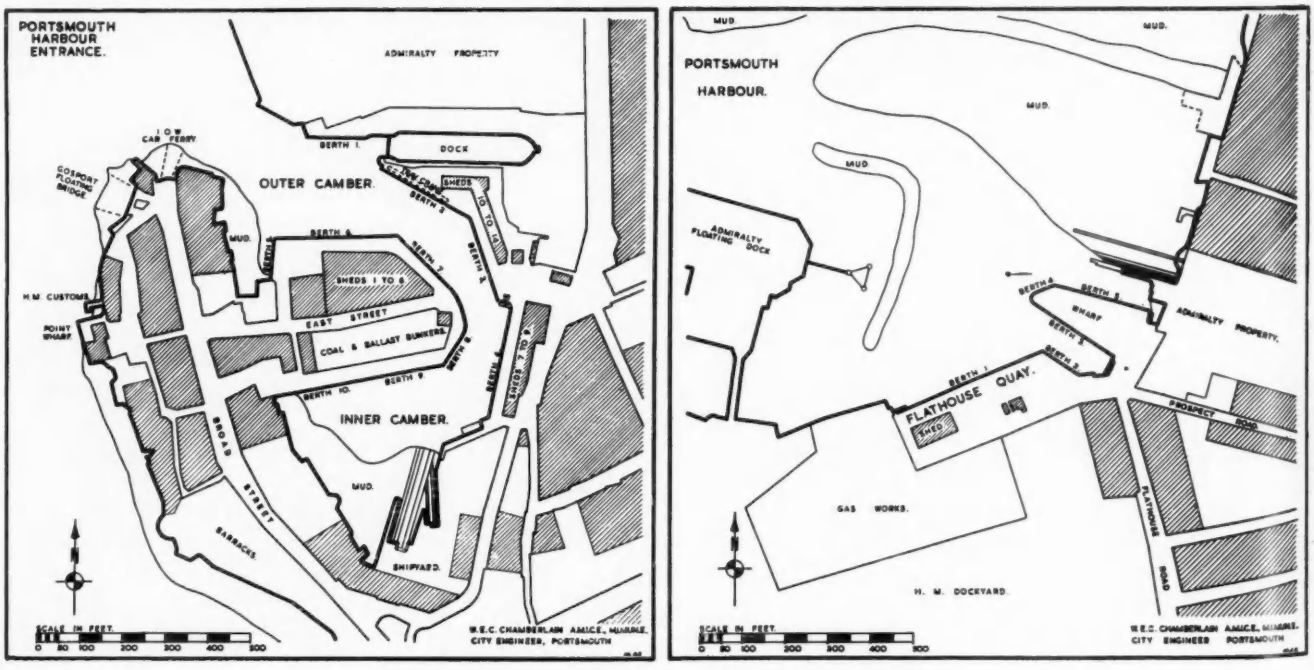


Fig. 2. Lay-out of the Camber (left) and Flathouse (right).

Cargo Handling at Portsmouth—continued

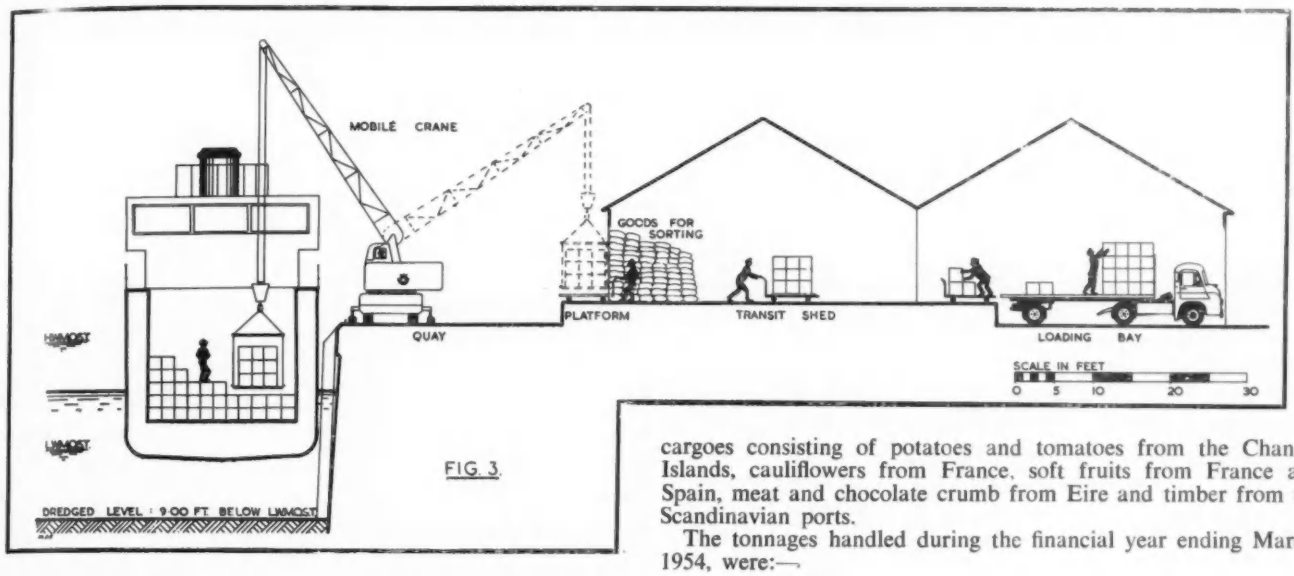


FIG. 3.

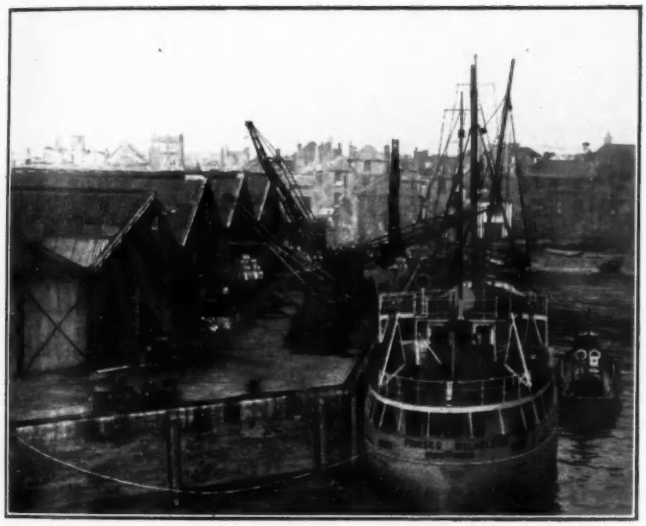


Fig. 4. Jersey potatoes being unloaded by mobile cranes.

Fig. 5. Loaded tray deposited on hand truck at loading bay of transit shed.

cargoes consisting of potatoes and tomatoes from the Channel Islands, cauliflowers from France, soft fruits from France and Spain, meat and chocolate crumb from Eire and timber from the Scandinavian ports.

The tonnages handled during the financial year ending March, 1954, were:—

Cauliflowers	25,000 tons
Fruit	6,300 tons
Potatoes	22,400 tons
Tomatoes	7,300 tons
Meat	2,400 tons
Chocolate Crumb	3,400 tons
Timber	23,000 tons
Coal	800,000 tons

In dealing with the perishable cargoes and in particular with those cargoes which have to be delivered at markets on time, speedy handling at the port is essential. Portsmouth has concentrated on this problem and since the war has evolved a method of handling these cargoes which enables a ship to be turned round in one tide. This method depends principally on the provision of readily accessible quays and the use of mobile cranes.

The Development of Cargo Handling Methods.

The port has been in existence for many years, and in the days of sail it was a busy area by the standards set in those days. The number of quays available were, however, limited, the depth of water not great and handling methods depended on the use of the ships' derricks.

Thirty years ago, when employment in the City was at a low ebb, it was realised by some that the port should be developed on more modern lines to secure regular commercial trade and this view was dramatically reinforced when a ship, laden with imports from the Channel Islands and bound for the Thames, developed engine trouble and put into the Camber. This ship was unloaded there and the cargo despatched to market where it arrived before similar cargoes coming by other ships to the Thames. Moreover, the cargo was fresher.

This not only supported the argument for development of the port, but also awakened in the shippers a keen interest in the possibilities of Portsmouth.

Transit Sheds.

The first major scheme of development took place in 1935 when a number of old houses, stores and other properties adjoining Berths Nos. 6 and 7 were acquired and demolished and the large transit sheds Nos. 1—6 (shown on the plan) were constructed, giving a floor area of 27,000 sq. ft.

It was, at this time, decided as a matter of policy, that single storey transit sheds should be provided as being the most economical and useful type of shed for the cargo likely to be handled at the Port. It was always realised that, by concentrating on perishable cargoes and ensuring speedy cargo handling methods, the port would attract a great deal of the cross-channel traffic, where ships up to 2,500 tons are commonly employed.

This has proved a very wise decision as the majority of the perishable cargoes handled pass from the ship, through the transit

Cargo Handling at Portsmouth—continued

Fig. 6. Loading lorries in transit sheds.

sheds for sorting into the various marks, and then direct onto lorries for immediate transport to market.

The port possesses no railhead, and relies entirely on road transport to move the cargoes to all parts of the kingdom. This provides a door-to-door service which has proved a great advantage to the importer, as the cargoes—and soft fruits in particular—suffer less handling and arrive at the markets in fresh condition.

The quays generally have a depth alongside of 6-ft at Low Water Spring Tide and are some 25-ft. in width. The floor of the sheds are constructed 3-ft. 6-in. above quay level; the doors have been so positioned that at least two cranes can be put to the ship to the fore and after holds respectively, and each crane can deliver through a separate door into the shed.

A loading platform is provided at each door projecting 6-ft. onto the quay and on this the cargo is landed. Provision is made for lorries to be loaded under cover, and there is ample floor area for the various cargoes to be separated into their different marks, sorted and loaded onto the vehicles. A diagrammatic sketch of the general layout is shown in Fig. 3.

Mobile Cranes.

It soon became apparent that a decision would have to be taken on the type of cranage to be provided. At that time the port had (and still has in use) a 8½ ton semi-portal electric crane on Berth 2, and two electric wall cranes on Berth 3, each capable of lifting 1 ton at 40-ft. radius. These wall cranes were fixed to the existing and only two storey sheds in the port and these sheds (reconstructed after war damage in World War II) provide storage on the upper floors for cargoes not immediately required for transport to market. They were originally constructed when the principal trade of the port was general cargo.

It was obvious that with any type of portal or semi-portal crane on a quay that crane could only be used on that quay; and for a port handling comparatively light cargoes, some of which are seasonal, this could mean having expensive equipment lying idle on one quay whilst its services would be badly needed on another.

However, mobile cranes had not then been used or developed to the extent they have to-day and in 1928, when Berth 7 was reconstructed to give deeper berthing facilities, provision was made for a semi-portal luffing jib crane by constructing a crane beam in the deck of the quay and providing a high level rail gantry along the front of the sheds.

The first mobile crane used at the port was purchased in 1935. This crane, manufactured by Ransomes and Rapier, had no roller path as on the modern mobile, but slewed on a king post. Moreover the duties called for an outreach of 25-ft. to plumb the ship's hold, and to lift at least 1 ton at that radius. This was a heavy requirement for a mobile crane in those days especially as 360° slewing was also required. The jib was lengthened with an extension and other modifications were made to meet the requirements and from early experiments such as these the modern mobile crane no doubt gradually evolved.

In 1936, the City Council purchased a Petrol Electric Mobile Crane made by Henry J. Coles Ltd., capable of lifting 2½ tons at 15-ft. radius and 1 ton at 25-ft. radius. This crane was fitted with a roller path, and was powered with a Ford Model "B" engine. The luffing motion was by means of the well-known Coles screw method.

These early mobile cranes proved the value of such equipment for a port the size of Portsmouth. They can be moved under their own power from one Berth to another, and put to ships as required, and in the numbers required; they can readily travel by road from the Camber to Flathouse, as the occasion demands; a breakdown does not immobilise a quay, as occurs with fixed cranes; and, so far as the Corporation is concerned, they are available for other profitable lifting work in the vicinity when not required at the port. They also form a valuable reserve for war time purposes.

Since these early days a fleet of 15 mobile cranes has been built up, which includes a Coles mobile tower crane mentioned later.

The type of crane in use to-day is a basic 8-ton fully mobile petrol-electric crane, fitted with a jib to give a lift of 1¾ tons at 29-ft. outreach, capable of slewing through 360°. Some of the machines are Ransomes and Rapier 8½ ton Super Mobile Cranes with an extension arm giving 35-ft. overall; and some are Coles Model S.1210 Aeneas, with a 35-ft. jib. Both types are rigged with a double fall purchase.

An outreach of 29-ft. enables the crane completely to cover the hold of the vessels using the port and full circle slewing avoids waste of time in manoeuvring and enables the cranes to work close to one another without fouling.

It has been found that the double fall purchase is particularly important when dealing with soft fruits such as tomatoes, peaches and strawberries, as the slower movement of the hook gives more sensitive control and avoids damage to cargoes. This is most essential if claims for damage to cargoes whilst discharging are to be avoided.

Method of Operation.

In discharging a vessel, two cranes and sometimes three, are put in to the vessel, working in the fore and after hold simultaneously. Iron trays, 6-ft. square, with lifting lugs on each corner, are lowered into the hold and the cargo is stacked on them. Fruit and vegetables are often imported in wooden boxes with open tops, so that skilful handling is required (Fig. 4).

When stacked, the iron trays are lifted by a 4 wire sling with a permanent spreader, and are discharged onto hand trucks stationed on the loading platforms of the sheds. These operations are shown in Fig. 5. The trucks are then run into the sheds, the cargo off-loaded for sorting or direct into the lorries, and the

Fig. 7. Mobile tower crane unloading timber at Flathouse.

Cargo Handling at Portsmouth—continued

truck returned to the loading bay. This sequence is repeated with additional trays and trucks, so no hold-ups occur (see Fig. 6).

The vessels used in the perishable cargo trade carry, on an average, about 30 tons and at peak periods up to four such vessels may require discharge in a day. These vessels are discharged in 6—7 hours, each crane working at the rate of about 20 tons per hour. The Corporation is responsible for berthage and cranage, the merchants or shippers for the handling and despatch of the cargoes.

Timber.

All the timber imports are discharged at Flathouse, and the mobile cranes are used in this operation. One crane is used to hoist the sling of timber from the hold of the vessel and load it on the quay, another crane then takes that sling of timber, travels back with it, and lands it on the stack wherever wanted. In this way, the stacks of timber are kept well clear of the working part of the quay, and the great advantage of the fully mobile crane is felt.

An interesting development of this discharging operation is the use of Model S.T.2310 Weland Coles Mobile Tower Crane (Fig. 7). This crane is capable of lifting 2 tons at a radius of 40-ft. when fitted with the 15-ft. tubular tower. It is fully mobile and can be operated with or without the tower. In Portsmouth, however, it is operated with the tower as the high cabin of the driver enables him to have a good view into the hold of the ship and to see his work. The outreach of the crane enables the timber to be stacked clear of the quay in one operation so that the one crane does the work of two smaller ones when handling timber.

Since the war, the Port has developed rapidly and the Docks and Airport Committee are fully aware of the constant need to improve facilities. Further development schemes are at present under consideration which it is hoped to carry out in the not too distant future.

New Railway Dry Dock

Installation at Groton, Connecticut, U.S.A.

By PAUL S. CRANDALL, B.S.

A modern railway dry dock designed by Crandall Dry Dock Engineers, Inc., Cambridge, Massachusetts, for the Electric Boat Division, General Dynamics Corporation, was recently built at Groton, Connecticut. In addition to its basic ability to lift 2,500 long ton vessels, this dock has other features making it a most complete and efficient dry docking facility.

General.

This dry dock consists of a cradle travelling on two inclined ways over a system of free rollers. The cradle is divided into two sections and is hauled by four cast-steel chains attached to the forward end of the outshore cradle. The ways are built of concrete, supported by steel piles for the first 100-ft. and the remaining 670-ft. are built of three tier greenheart timber, supported by greenheart piles.

Cradle.

An all welded steel cradle frame consisting of heavy transverse beams, supported by two longitudinal girders on runners, provides a relatively simple structure which distributes its load equally to each way. The deflection of the beams under load helps to distribute possible load concentrations to adjacent beams. The runners are built up to provide a deck profile independent of the track gradient and suitable for easy access to the hull of submarines. The underside of these runners have a heavy shoe plate which bears on a series of cast-iron rollers, which in turn bear on the rail plate of the track structure below.

The flush timber deck has been sheathed for a width of 24-ft. to prevent sand from sand-blasting from falling down to the ways below. Special troughs on each side of the long transverse beams provide a recess for bilge block chains.

Steel uprights are mounted at the ends of the long transverse beams which support wooden docking platform from which the docking crew can centre the vessel when the remainder of the cradle is submerged. All sliding bilge blocks are operated by winches on the starboard uprights, permitting the port side to be left open for access to heavy repair operations. Twelve keel blocks, which normally fall aft of the knuckle of submarines, and hence interfere with in line docking because of their height, have been made sliding in groups of three so that they may be moved aside by hand operated winches on the starboard uprights.

An important feature of any dry dock structure is to have it so that it can be maintained at a minimum of expense. In this particular case, the steel cradle was divided into two, so that the forward half, which is always accessible at low tide for painting, can also be easily removed by floating it with a barge, and the after half, which is not accessible at low tide can be pulled up to replace the forward section.

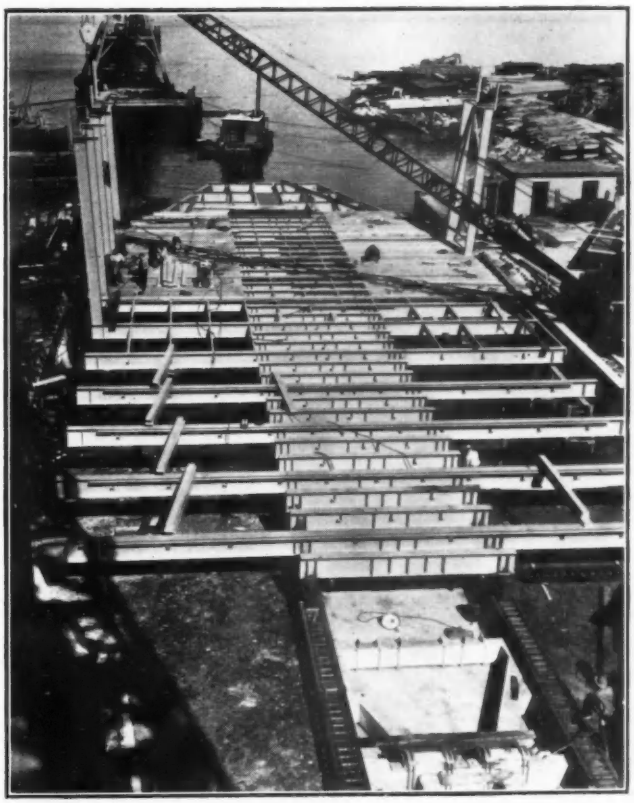


Fig. 1. Outshore cradle during erection of steel uprights.

By installing compressed air, salt water, fresh water and welding outlets, both along the side walls and on the cradle deck where needed, this dry dock is fully equipped for repairing ships efficiently.

Foundation.

By using a foundation of greenheart piles and an underwater timber track also made of greenheart, it was possible to carry the relatively high load concentrations from the cradle on two single rows of piles. The high strength of the greenheart, both for pile tip bearing and side grain bearing, permitted some saving in the required quantity. Since greenheart resists marine borer attack in temperate waters, no sheathing was required. The track structure had to be entirely bolted because greenheart readily splits if drifting is attempted.

The inshore 100-ft. of track was made of reinforced concrete, supported by steel piles, since this could be poured in the dry at low tide. The timber track structure was built as a unit ashore

New Railway Dry Dock—continued

and launched overboard. It was then lowered over the pre-cut piles and secured by means of drift bolts.

Roller System.

The importance of the roller system of a railway dry dock is second only to its hauling machine and chains. A poor roller system can result in high friction, rapid wear of rollers and rails, breaking of roller flanges and the derailment of the cradle.

To ensure smooth and safe operation of this dry dock, a new type of steel roller frames were installed equipped with bushings for holding the rollers square, and flexible connectors between the frames, which permit self alignment. Recent tests of a smiliar roller system under load has shown the friction to be less than one per cent. of normal load.

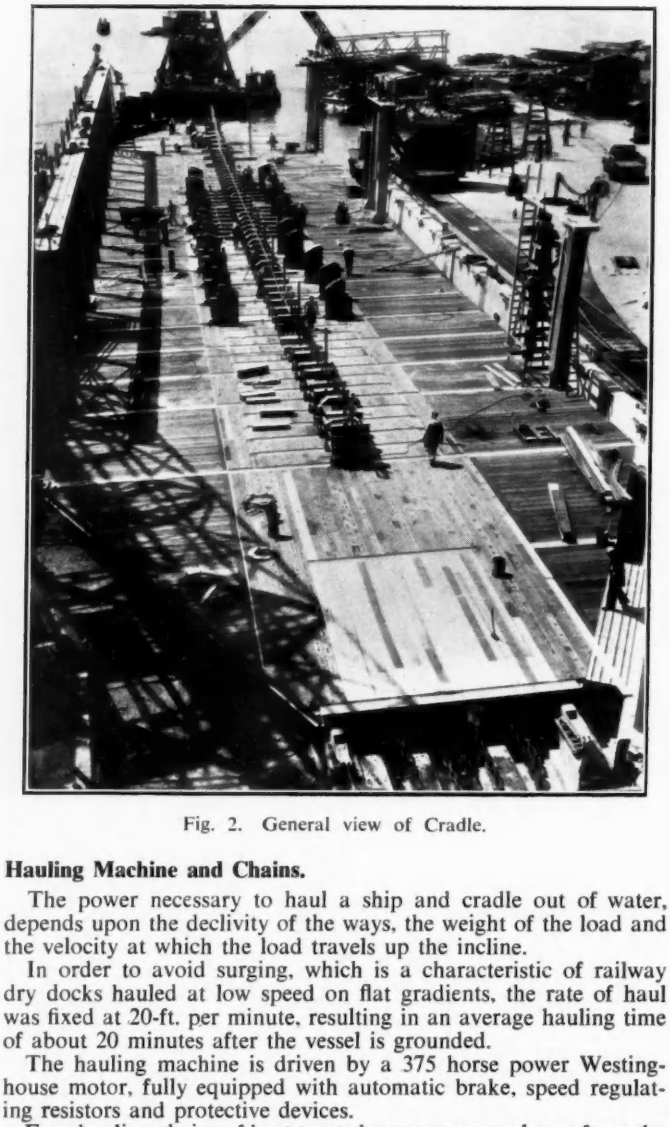


Fig. 2. General view of Cradle.

Hauling Machine and Chains.

The power necessary to haul a ship and cradle out of water, depends upon the declivity of the ways, the weight of the load and the velocity at which the load travels up the incline.

In order to avoid surging, which is a characteristic of railway dry docks hauled at low speed on flat gradients, the rate of haul was fixed at 20-ft. per minute, resulting in an average hauling time of about 20 minutes after the vessel is grounded.

The hauling machine is driven by a 375 horse power Westinghouse motor, fully equipped with automatic brake, speed regulating resistors and protective devices.

Four hauling chains of heat treated manganese steel pass from the cradle over four sprocket wheels on the main shaft of the hauling machine, and then pass along the track, where the lower ends are attached to smaller backing chains which pass through underwater sheaves, and return to the cradle to which they are attached, thus forming an endless chain. This arrangement permits the chains to be kept tight at all times.

Maintenance and Cost.

The steel cradle of a railway track must be painted every five years if immersed in sea water. This has been provided for with the divided cradle. In addition, however, the forward runners being sealed box girders, need only exterior painting.

The greenheart track should remain intact for up to 100 years. However, its rail plates will need renewal about every 30 to 40 years. The inshore concrete track will only suffer the effects of freezing and thawing, which is easy to maintain. Only the hauling chains and the iron rollers have limited life, but even these should last 15 to 25 years, depending on the intensity of use.

The welded steel cradle required about fifteen per cent. less steel than that of a similar riveted structure, and because of the field welding, no shop erection was required.

The two-way design versus the four-way track and cradles previously built, saved about twenty-five per cent. in pile and track timber requirements, and reduced the fabrication cost for the cradle, since only two runners were needed instead of four. As a result, this modern railway dry dock was completed at a cost of less than $200.00 per short tons lifting capacity.

Underwater construction was contracted out to Merritt, Chapman and Scott Corporation. The cradle fabrication and erection was done by the Electric Boat Division.

Harbour Obstruction by Sunken Vessel

Legal Action Regarding Costs Incurred

In June of this year the House of Lords considered the question whether the expenses of raising a sunken ship amounted to a liability to damages of the ship owner under the Merchant Shipping Act and whether such expenses have any relation to the costs of damage done by the vessel, " Stonedale No. 1."

The matter arose under the Manchester Ship Canal Act of 1897. The appellants before the House of Lords were the owners of the barge, " Stonedale No. 1," which had sunk in the Manchester Ship Canal near Hooton Wharf and became an obstruction. The Manchester Ship Canal Co. raised the vessel at their own expense and claimed the cost of doing so, £7,609 1s. 4d., from the appellants under Sect. 32 of the Manchester Ship Canal Act of 1936 which provided that in such a case the Company might raise the vessel to clear the canal and recover from the owners all the expenses incurred. The appellants, however, sought to limit their liability under the Merchant Shipping Act, 1900, Sect. 1 and 3, and the Merchant Shipping Act of 1894 which limited the liability in damages of shipowners where their ship had caused loss or damage and included cases where the liability arose by virtue of an Act of Parliament. They further relied on Sect. 9 of the Manchester Ship Canal Act itself which limited the liability in damages of shipowners for damage done by their ships within the canal. In both cases liability could only be limited if the loss or damage was caused without the actual fault or privity of the shipowners but the appellants satisfied this condition and would, if successful have reduced their liability to £1,681 2s. 6d.

Their Lordships said that the Merchant Shipping Acts only enabled shipowners to limit their liability in damages. The Manchester Ship Canal Company was not seeking to make the appellants liable in damages but to recover the expense of raising their sunken vessel. It had been suggested that the Canal Company had a common law right to recover the cost from the appellants and whether or not a shipowner faced with such a claim could limit his liability under the Act of 1900 there was no similar right when the claim, as here, was founded wholly on statute. If this was an anomaly so was the Harbour Docks and Piers Clauses Act, 1847, which made the vessel's owner responsible for damage done by her to a dock though there was no negligence whatever. The vital words in the Acts in which the appellants relied were " be liable in damages." The relief given to shipowners was in respect of their liability to damages and nothing else.

The plea under Sect. 9 of the Manchester Ship Canal Act failed for substantially the same reason. There it was injury or damage to the canal which gave rise to the liability, the right to recover the expenses of raising a sunken vessel was given irrespective of the right to recover for such injury or damage. Accordingly, the appellants claim to limit their liability was dismissed.

Mechanical Handling at Wilmington

Storage Capacity Increased

By JOHN GRINDROD, B.A. (Com.)

How palletised loads and the use of fork-lift trucks can make all the difference to a small port struggling along with out-of-date methods is the story lying behind the recent developments at the American port of Wilmington, Delaware. Under the old system the transit shed had become a bottleneck and congestion and delay were resulting in ships being lost to other ports. With the adoption of mechanical handling, however, the terminal has been able, not only to hold its own, but actually to attract a greater volume of shipping with lower rates.

Established in 1917 this city-owned marine terminal is operated by the Board of Harbour Commissioners and is situated on the south-west corner of the confluence of the Delaware and Christiana Rivers. Located on a frontage of 2,400 feet, the docks can accommodate four freighters at a time. In addition, a 2,500-ft. sheet-pile jetty provides facilities for a tanker. The entire length of the dock is served by three diesel gantry and four locomotive cranes.

Consisting of two one-storey buildings, each 120-ft. wide by 500-ft. deep, about 100-ft. apart, the two warehouses run at right angles to the dock and between them form part of the arms of a U-shaped complex, whose base is the 400-ft. wide and 120-ft. deep transit shed, which faces the docks. Broad, truck-level loading platforms run along the east and west sides of both warehouses, the two outside platforms opening on to roadways. The inside platforms serve the four rail sidings located between the warehouses.

The accompanying aerial photograph of the port clearly illustrates its position and present layout.

Formerly, the 48,000 square foot transit shed was used for temporary storage. As it was unloaded on the docks, cargo was brought to the transit shed where it remained until it could be stored or re-shipped, and it was because the transit shed could not be cleared fast enough that congestion occurred.

Fortunately, with all dock and floor levels substantially the same, the terminal was ideally suited to mechanical handling methods and the authority has now installed ten Towmotor Fork-Lift Trucks, which, operated from four to 12 hours a day, six to seven days a week, each work on an average 2,500 hours per year. Their use has kept cargo moving through the transit shed. Ships unload without delay and labour lay-offs are reduced.

Because of the prompt transfer of shipments only 18,000 square feet of transit shed are now needed for temporary storage and 30,000 sq. ft. has been added to the revenue-earning storage space.

General view of the Port of Wilmington.

Bales of jute being stored 20-ft. high, doubling the storage capacity in this area. Twelve bales at a time are being stacked by fork-lift truck.

Consisting in the main of wood pulp, jute, webbing, newsprint, canned goods and miscellaneous bagged materials, 80 per cent. of the terminal's traffic is water-borne. More recently there has been a rapid growth in shipments of lumber from the United States West Coast and British Columbia. The remainder of the terminal's traffic consists principally of seasonal feeding stuffs and fertiliser supplies, such as cotton-seed meal, powdered whey, fish meal and meat scrap, limestone, rock phosphate and various grains. Winter storage of these commodities runs as high as 18,000 tons.

Newsprint arriving by rail is also stored for a Wilmington newspaper, the 3,500-lb. rolls of paper being unloaded by fork-lift truck at the rate of a roll a minute, moved to storage and stacked two-high on end. The truck travels about 200-ft. each journey and an entire railway wagon load can be dealt with in 20 minutes.

For the handling of wood pulp from railway wagon to storage ten men were formerly required: two loaded hand trucks in the railway wagon, four men pushed the trucks to storage; and four more stacked the pulp in storage. Now one operator on the fork-lift truck and two men in the railway wagon, who make up pallet loads, do the same job with a resulting labour saving of 70 per cent.

The additional storage space has been achieved partly by increasing stacking heights 50 per cent. and more over former hand stacking methods. Bales of jute, for instance, could only be stacked two-high manually, but can be stacked four-high by fork-lift truck, utilising the 20-ft. storage height and doubling storage capacity. Whereas, formerly, a gang of 12 men was required to move jute from the transit shed to storage or to outgoing freight car, this is now achieved by one man and a fork-lift truck.

Time is also saved. Before, ten men could deal with 600 bags of feeding stuffs in three hours. Now, one operator and a fork-lift truck, together with four men to de-palletise the bags, can load a 30-ton railway wagon from storage in 90 minutes.

Colombo Port Development.

The Government of Ceylon has accepted the claim of the French contractors, Compagnie Industrielle de Traxaux, to the Colombo Port Development Scheme that they are not responsible for the delay in completing the scheme. The Government will now have to pay the extra money claimed by the contractors to complete the scheme.

Personalia

Retirements and Resignations

The retirement, as from the 1st October, 1955, is announced of **Sir William Halcrow,** M.I.C.E., M.I.Mech.E., who has been for many years Senior Partner in the firm of Sir William Halcrow and Partners, Westminster.

Sir William began his professional career as a pupil with Thomas Meik and Sons, MM.I.C.E., and during his training worked on docks, harbours, railways and hydro-electric works. Later, whilst on the staff of Topham, Jones and Railton Ltd., he gained experience on the constructional side on the King George V Dry Dock and Johore Causeway, Singapore. During the 1914-18 war he was in charge of submarine and land defences at Scapa Flow.

Since 1922 Sir William has been a Consulting Engineer. In recent years he has acted as Chairman of the Panel which reported on the Severn Barrage Scheme and of the Panel reporting on the Kariba and Kafue hydro-electric schemes in Rhodesia. He has also acted as adviser on the development of the Volta River and on schemes for underground railways in Auckland for the New Zealand Government. Sir William was the engineer for Kinlochleven, Lochaber and Grampian Water Power Schemes, and engineer to the North of Scotland Hydro-Electric Board for the Glen Affric, Moriston and Garry areas of Inverness-shire. Other of his works include the Thurgoland and Woodhead main line railway tunnels, tube railways, the Claerwen Dam, steam power stations and the harbour works at Beira, Sunderland, Shoreham and the Gold Coast.

During the 1939-45 war he was responsible for many tunnels in London, including deep level shelters for the Ministry of Home Security, and advised the War Office on the design and construction of Mulberry Harbours and on emergency ports in this country and abroad.

Sir William is Past President of the Institution of Civil Engineers (Telford Gold Medal), Past Chairman of the Association of Consulting Engineers, Past President of the British Section of the Societe des Ingenieurs Civils de France (Prix Annuel Gold Medal), Chevalier de la Legion d'Honneur, Officier de l'Ordre d'Etoile Noir.

He was President of the Smeatonian Society of Civil Engineers, 1953, Hon. Member Institute of Royal Engineers, Government Representative on the Permanent International Association of Navigation Congresses, Vice-President of the International Commission on Large Dams of the World Power Conference, Chairman of British Section, International Commission on Irrigation and Drainage, Colonel-Commandant (Retd.) Engineer and Railway Staff Corps., R.E. (T.A.), President Section G (Engineering) British Association 1947. He was also a member of the Engineering Advisory Committee to the War Cabinet, and of the National Consultative Council of the Building and Civil Engineering Industries Ministry of Works, and Adviser to the Air Ministry (Bomber Command). A member of the Advisory Council of the Department of Scientific and Industrial Research and Chairman of the Hydraulics Research Board and the Froude Tank Sub-Committee, Sir William is also on the Executive Committee of the National Physical Laboratory, and Honorary Consulting Engineer to the Imperial War Graves Commission and a member of the Royal Fine Arts Commission.

Mr. Mogens Blach has resigned his post as general manager of the Port of Copenhagen Authority. Mr. Blach, who is 67 years of age, has accepted an offer from Kampsax, a Danish contracting firm, to supervise, on their behalf, the construction or extension of eight ports in Turkey, Syria and Iran.

Before he joined the Port of Copenhagen Authority, in 1938, Mr. Blach was chief engineer of Kampsax, and in that capacity was responsible for the construction of the trans-Iranian railway and part of the railway system in Turkey.

Originally chief of the building department of the Port of Copenhagen Authority, he has, during his term of office as general manager, carried through improvements and modernisation of harbour installations aggregating £2,260,000, including the construction of the Phovestenen oil harbour, the largest of its kind in the Scandinavian and Baltic area.

Mr. Blach has been succeeded by Mr. Aage Hendrup, a doctor of law specialising in shipping and port legislation. Before he joined the Port of Copenhagen administration 10 years ago, Mr. Hendrup was a civil servant in the Danish Ministry of Public Works.

The retirement is announced of **Lieut.-Col. P. A. J. Hernu,** chairman of the Colombo Port Commission for the past ten years. During his term of office a large port development scheme costing Rs. 120 mn. has been initiated.

Lieut.-Col. Hernu served during the Second World War in the Corps of Royal Engineers, in North Africa and Italy. He was mentioned in despatches in 1945, and took up his appointment in Colombo in the same year. He drafted the Colombo Port Administration Act in 1951. He is a member of the Order of the British Empire and the Institute of Transport.

The New York Waterfront Commission has announced that their executive director and general counsel, **Mr. Samuel Lane,** has resigned. In accepting the resignation, the commission, which represents the New York area dockland interests in both New York State and New Jersey, stated that Mr. Lane's assistant, Mr. Irving Slonin, would succeed him on a temporary basis.

Mr. Lane is to remain available for special assignments.

Appointments

The British Transport Commission announce the appointment of **Mr. W. Shaw Evans,** A.M.I.C.E., G.I.Mech.E., to be Senior Assistant Engineer (Mechanical and Electrical) with the South Western Division of British Transport Waterways, at Gloucester.

Mr. Shaw Evans began his career by serving a 5-year apprenticeship with the former Great Western Railway Company at Swansea and Port Talbot Docks and later at Swindon Locomotive Works. At the conclusion of his apprenticeship, he was transferred to the Head Drawing Office of the G.W.R. Company at Swindon where he was engaged on port development work. In 1951 Mr. Shaw Evans was appointed an Assistant Electrical Engineer with the Port of Bristol Authority.

The appointment as Dock Master, Barry Docks, is announced of **Captain A. W. Allen,** who has been since 1952 Dockmaster at Port Talbot. Captain Allen had 14 years at sea prior to joining the former Great Western Railway Company as a Piermaster at Newport Docks in 1929. In 1939 he was promoted Assistant Dockmaster, Newport Docks, and in 1945, Assistant Dockmaster, Cardiff Docks.

Irish Port Authorities Association

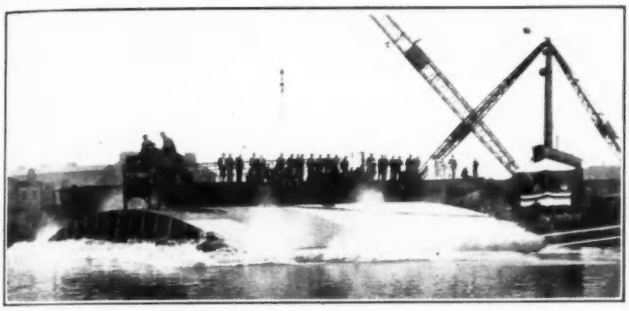
Mr. S. MacKenzie, chairman of the Dublin Port and Docks Board has been elected chairman of a new body, formed last September, the Irish Port Authorities Association. The new Association has among its objectives the pursuit of a claim for income tax relief which was made some years ago by Irish harbour authorities. There is also under consideration the possibility of acquiring dredging equipment co-operatively between several ports, there being insufficient work available for such equipment at any one port.

Manufacturers' Announcements

New Outer Gates for Immingham Dock

The first leaf of a new pair of lock gates, built for the British Transport Commission, Humber Ports, was recently launched at the works of Head, Wrightson & Co. Ltd., on the River Tees.

These gates are for the 90-ft. wide outer entrance to Immingham Dock and are of all welded construction. Each leaf consists of a mild steel framework of vertical and heel and mitre posts, with 17 horizontal plate decks enclosed by mild steel skin plates. There is a centre watertight bulk-head and two off-centre diaphragms, constructed in fitted panels between the decks. Man-holes are provided to facilitate access to all internal compartments. The approximate overall dimensions of each leaf are 54-ft. x 50-ft. 3-in. x 8-ft., and the approximate weight of each leaf is 190 tons.



Dock gate at moment of launching.

The new welded gates replace a pair of riveted wrought iron gates, installed by the same Company in 1908 and the new welded design effects an approximate saving in weight of 25 per cent. Head, Wrightson & Co. were responsible for the design, fabrication and building of the gates to the Commission's specification.

Inspection of workmanship has been carried out by the staff of the Chief Dock Engineer, Humber Ports, British Transport Commission.

Compound for the Universal Protection of Wood

This new type of compound, called "Selonel W," for the universal protection of wood has come into prominence through the development of organic compounds and metallo-organic salts in the laboratories of the New System Manufacturing Co. Ltd.

The compound combines a new type of universal protection of wood against fire, weather, dry-rot, etc., and can be applied without special equipment. This may be by immersion, brush or spray treatment and it leaves the treated wood clean, odourless and practically unstained; when applied to new wood-work in its finished state it does not cause swelling or shrinking, nor does it interfere with the subsequent application of paints or varnishes. It ensures that treated wood is fireproof and at the same time it protects the wood against rot, various attacking organisms and against weathering, and the treatment lasts for a long time. In addition, treatment with the compound gives the wood protection against the destructive effects of moulds, fungi and animal and vegetable organisms, and offers one universal means for the protection of all wooden structures. Satisfactory results are shown even when treated wood has been continuously soaked in water.

The fire-proofing of wood is achieved by the formation, after treatment, of a compound on the surface which has a continuous coat of an inorganic mass which adheres very strongly to the wood and during fire a new layer of gases above the inorganic coating is developed. This combination on the surface of the wood in extreme cases, becomes carbonised but does not catch fire and will not burn away. In addition it prevents the spread of fire on all wooden components.

The compound can be sprayed or brushed on or the wood can be immersed. If immersion is used, it should be continued for 20 to 30 minutes depending on the density of the wood. After drying of the first coat, a second coat can be applied in the same way in cases where vulnerability to fire makes this desirable.

A Tall Crane for Newcastle

The 30-ton level-luffing jib crane recently erected in the Neptune Shipyard of Swan Hunter and Wigham Richardson, Ltd. forms a new land-mark on Tyneside; its height of 215-ft. rendering it conspicuous even in that city of tall cranes. Built at the Renfrew works of Babcock and Wilcox Ltd. it is a level-luffing crane of the Babcock Lever type, in which the load remains at a constant level at all radii of the jib. The portal type undercarriage is itself approximately 70-ft. high to the top of the centre post, the overall

New crane in operation at Neptune Works.

height of the crane in its highest position i.e. at minimum radius, being 215-ft.

The capacity of the main hook is 30 tons between the minimum radius of 36-ft., and 75-ft. from which it decreases to 10 tons at the maximum radius of 142-ft. There is an auxiliary hook with a capacity of 2 tons at all radii.

The portal type undercarriage runs on tracks at 27-ft. 6-in. centres and has clearance for rectangular loads of 20-ft. 6-in. wide at 10-ft. high and 13-ft. 6-in. wide at 14-ft. high.

The erection which was carried out with aid of a floating "Titan" crane presented a number of problems on account of the length of the jib (approximately 165-ft.) and its weight of 32 tons for the jib and jib lever. The revolving cradle complete with its ballast tank weighed 80 tons, and 90 tons of ballast was added when the crane was complete.

Erection was carried out by Messrs. Swan Hunter and Wigham Richardson with skilled supervision from the makers.

Change of Address

The International Cargo Handling Co-ordination Association announces that as from 17th October, 1955, their address will be 1, Victoria Street, London, S.W.1. Telephone: Abbey 2102.

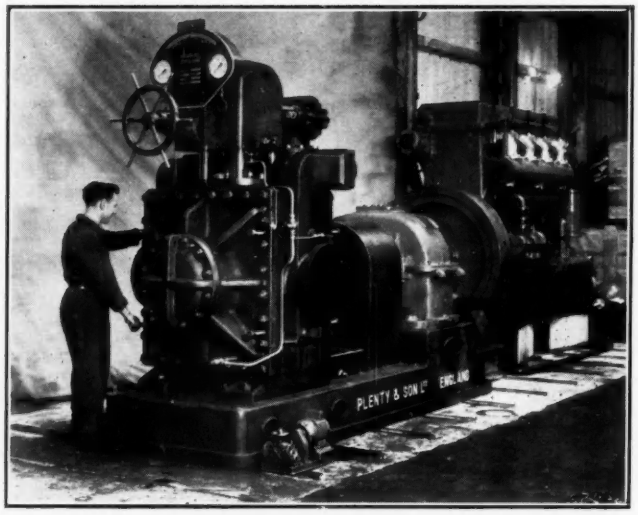
Manufacturers' Announcements—continued

Large Rotary Bunkering Pump

A variable-output rotary displacement pump capable of handling 350 tons of oil per hour has been supplied by Plenty and Son, Ltd., Newbury, Berkshire, for the British Petroleum bunkering installation at Aden. This is the largest pump yet to have been built by this company, although the type has been in production since 1935.

The capacity is 1,500 g.p.m. at 135 r.p.m. When absorbing 200 b.h.p. this output can be maintained with a variety of oils, ranging in viscosity from 50 sec. Redwood No. 1 at 100°F. to 11,000 sec. at a delivery pressure of 100 to 125 p.s.i. Oils up to 20,000 sec. Redwood No. 1 at pressures up to 300 p.s.i. can be handled, when absorbing 500 b.h.p. During tests at the company's works, using a 200-b.h.p. Crossley Diesel engine, the pump was run with light oil at 400 p.s.i. at reduced output. It can develop 26.5-in. of mercury vacuum. It is entirely self-lubricating and is fitted with a pilot-operated relief valve with a range of from 50 to 500 p.s.i.

The design of the Plenty Universal pump allows for reversible and infinitely-variable flow. The main body of the pump has the suction and delivery branches mounted in the horizontal plane. Inside the main body there is a sliding block which can be raised or lowered relative to the shaft centre line. The cylindrical rotor, which is mounted in this block and rotates in a specially ported



liner, has four rectangular ports 90 degrees apart. This rotor acts purely as a distributor; it is turned by blades on the driving shaft which slide freely in two slots cut through the shaft at right angles. Ball and roller bearings support the shaft concentrically with the main body. As the shaft is turned the blades slide radically in the slots and traverse angled faces in the rotor bore, forming four oil chambers.

The Plenty pump lends itself admirably for proportioning duties. Two or more pumps may be driven from a common prime mover at a uniform speed. The control gear of each pump is linked, whilst calibrated proportioning controls allow each pump to be individually set to a predetermined output. Once the desired ratio has been achieved the rate of flow may be increased or decreased by operating a master control wheel without altering the proportions of the mix or the speed of the pumps.

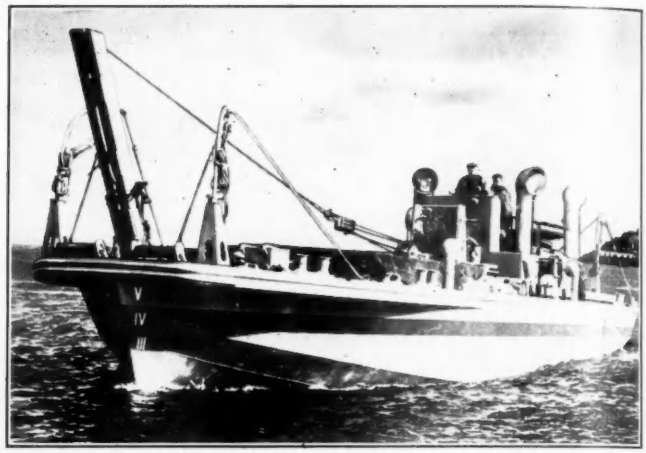
The pump illustrated has a capacity of 350 tons per hour; the range however has recently been extended to 750 tons per hour.

Motor Barge with Lifting Horn

The Fairmile Construction Co. Ltd., Cobham, Surrey, have recently completed at their Berwick Shipyard a 60-ft. self-propelled lifting lighter for Sierra Leone. For most of the time she will be used for carrying up to 50 tons of cargo, but she will be required on occasions for buoy lifting operations, involving weights not exceeding seven tons.

The welded steel hull is of double chine design with a moulded breadth of 18-ft. and a depth of 6-ft. Plating is ¼-in., with double thickness on sides and deck at the forward end.

For motive power a pair of 60 h.p. Gardner Diesel engines with reduction gear are installed. Each unit is arranged to operate by belt a 1¼-in. Parsons pump for dealing with the contents of the aft peak water ballast trimming tank, which holds approximately 2,000 gallons. The output of each pump is 2,700 gallons per hour at 1,000 r.p.m.



The gantry is made from 9-in. x 3-in. channel with ⅜-in. tie plates and 6-in. x 3-in. channel ties; it is designed to hinge aft on to the deck when not in use. The Gibbons hand winch is of 3 tons capacity.

The two anchor davits forward are also intended to be used for helping to haul the moorings on board. Ground tackle is provided aft, all three anchors being 84 lbs. in weight with 30 fathoms of chain. Bow fairleads consist of horizontal rollers 2-ft. long.

On trials the vessel had a displacement of 41½ tons. The loaded draught is estimated at 5-ft. and the average speed was 8.5 knots.

FOR SALE

15-TON PORTABLE ELECTRIC CRANE, 74-ft. balanced jib, level luffing gear, rope operated, new, 1951. Apply Box No. 175, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

DOUBLE TEXTURE RIDING COATS. Full length and ¾ length. Ex-Govt. Much below manufacturer's price. Write: SURPLUS TEXTILES, 32a Booth Street, Manchester 2. CENtral 5547.

USED FORDSON MAJOR BUFFER TRACTOR for sale capable of moving 100 or more of rolling stock. In very good condition fitted with petrol engine. £150. Chaseside Motor Co. Ltd., Castle Street, Hertford. Tel. Hertford 2456.

APPOINTMENTS VACANT

SENIOR CIVIL ENGINEER required for Head Office appointment in London. Duties will mainly be connected with the Administration of Overseas Contracts and will involve periodic visits abroad. Applicants should have Contract Experience on Heavy Civil Engineering works including experience of Marine Works. A knowledge of Estimating would be an advantage. The appointment could be delayed for several months to suit a suitable applicant's arrangements. Apply Box No. 173, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

CIVIL ENGINEERING ASSISTANT with dock and harbour design experience required by Westminster consultants. Salary to be based on qualifications and experience but £750 upwards. Box No. 174, "The Dock and Harbour Authority," 19 Harcourt Street, London, W.1.

BRITISH TRANSPORT COMMISSION (Docks Division) invite applications for a position as Reinforced Concrete Designer in the Chief Docks Engineer's Department, Hull. Applicants should preferably have had experience in relation to dock and harbour structures and be fully qualified in reinforced concrete design. Salary: £815 rising to £850 per annum after two years.

The candidate selected for appointment will, where eligible, be expected to join a contributory superannuation scheme.

Applications giving details of age, experience and present position should be submitted to the Chief Docks Manager, British Transport Commission, Dock Office, Victoria Square, Hull.